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A DESCRIPTION
OF THE
DoD TEST AND EVALUATION PROCESS
FOR ELECTRONIC WARFARE SYSTEMS

Distribution Unlimited

31 July 1996

~~13 JUNE 1994~~

DIRECTOR, TEST, SYSTEMS ENGINEERING AND EVALUATION
Office of the Under Secretary of Defense
(Acquisition and Technology)
The Pentagon
Washington, DC 20301

Revision ~~1~~2
July 31, 1996~~September 18, 1995~~

FOREWORD

Historically, Electronic Warfare (EW) Systems have been complex and frequently present a dichotomy because they represent high technology at its best and its worst. At its best, EW can be a major technical and tactical edge (force-multiplier) over potential adversaries (as demonstrated during recent military operations); while at its worst, EW can incur vicious spiraling costs and can push risk and technological state-of-the-art to keep pace with, or exceed, technical advances in potential threat systems and their counter-countermeasures (CCM). Needs for new EW capabilities arise usually in response to known or expected actions by a potentially hostile entity about which little may be known. The need for rapid, decisive response can cause the acquisition process for new EW capabilities to be less conventional and more dynamic than other types of major systems. As development proceeds, additional intelligence may become available that may cause abrupt changes, or as a minimum a re-analysis of the requirements, i.e., has the threat changed, expanded, or increased in complexity enough to make our new capability ineffective when fielded? Because EW is so dependent upon the use of current, and in many cases, highly sensitive intelligence sources and methods, the openness of information relating to new EW capabilities must carry the same level of protection to prevent revealing details of the capability.

EW systems, to be effective, have to be flexible in responding to a multiple-threat, multispectral environment which, in turn, leads to complex EW systems. Trends indicate that current and future EW systems will be required to be integrated with or carried by a variety of platforms. New capabilities must respond in as close to real-time (nanoseconds) as technically and operationally feasible. This infers that the systems must keep pace with the state-of-the-art in not only EW technologies, but also in the technologies they must counter, e.g., low-probability-of-intercept, low observables, high-power microwaves.

EW systems should bring added value to the warfighter. The effectiveness of EW is difficult to measure but can be tied directly to the survivability of the assets it is intended to protect. It should be as non-intrusive as possible on the warfighting itself. Because the art of EW has some unconventional characteristics and demands, its conformance to accepted acquisition practices has often been outside the perceived norm. However, from a T&E process point of view, EW systems development is not so different or special that, with the proper precautions in place to prevent premature revelation of capability, it cannot be adapted to a standardized DoD T&E process. The T&E process for EW systems described in this document represents a compendium of best T&E practices and procedures and is designed to allow that conformance to be achieved.

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1. INTRODUCTION

1.1 Objective. The principal objective of this document is to describe a rigorous, standardized, disciplined test and evaluation (T&E) process for Electronic Warfare (EW) systems. The Process is comprised of functions and steps to assist the decision making process leading to progressive acquisition of mission-required EW systems.

1.2 Background.

1.2.1 In mid-1993, the Under Secretary of Defense (Acquisition & Technology), Director, Test and Evaluation convened a task force to develop a process for EW systems T&E. This task force, with the concurrence of their Service Executives, produced a DoD T&E Process for EW systems described in this document. DoD Instruction 5000.2, *Defense Acquisition Policies and Procedures*, was used as the baseline for this process. That is, DoDI 5000.2 provide<u>d</u>~~s~~ the framework around this DoD T&E Process for EW systems. <u>This revision reflects the changes in the acquisition process incorporated in the new DoD 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs.*</u> This document supports <u>DoD 5000.2-R</u> ~~DoDI 5000.2~~ and is not in conflict with the 5000 series of documents.

1.2.2 Specific program reporting requirements are announced separately by DT&E and OT&E. The T&E process described herein may be applied to EW systems that conform to the definition in Paragraph 1.3.1 of this document. This definition is from CJCS Memorandum of Policy (MOP) No. 30 that promulgates Command and Control Warfare (C2W) as a military strategy. In addition to establishing C2W as a new strategy, MOP 30 effectively eliminates Command, Control, Communications Countermeasures (C3CM) as a military philosophy and a working definition by replacing it with C2W (see Paragraph 1.3.2). Two other changes promulgated by MOP 30 in the shift from C3CM to C2W are: 1) to change the term "jamming" to the much broader military action of EW and 2) to add psychological operations (PSYOP) as a principal military action. The latter (along with operational security (OPSEC)) is not addressed in this document.

1.3 Terminology.

1.3.1 <u>Electronic Warfare (EW)</u>. Electronic Warfare is a military action involving: 1) the use of electromagnetic or directed energy to attack an enemy's combat capability, 2) protection of friendly combat capability against undesirable effects of friendly or enemy employment of EW, or 3) surveillance of the electromagnetic spectrum (also known as EW Support) for immediate threat recognition in support of electronic

warfare operations and other tactical actions such as threat avoidance, targeting, and homing.

1.3.1.1 Electronic Attack (EA). Involves the use of electromagnetic or directed energy to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability. Representative examples include, but are not limited to: jamming, e.g., noise, repeater; deception countermeasures (DECM), e.g., false targets, range denial, velocity (Doppler) denial; physical kill, e.g., high-power microwaves.

1.3.1.2 Electronic Protection (EP). Involves the actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy employment of EW that degrade, neutralize or destroy friendly combat capability. Representative examples include, but are not limited to: automatic warning sensors, e.g. radar homing and warning (RHAW), missile attack warning, laser warning; decoys/RPVs; expendables, e.g., chaff, flares (IRCM); electronic counter-countermeasures (ECCM), e.g., antijam techniques, radar-cross-section (RCS) reduction, wartime reserve modes (WARM), and anti-air, anti-radiation missile (AARM).

1.3.1.3 Electronic Support (ES). Involves actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate sources of intentional and unintentional radiated electromagnetic energy for the purpose of immediate threat recognition. Representative examples include, but are not limited to: detection, direction finding (DF), precision emitter location, signal parametric analysis, threat system classification.

1.3.2 Command and Control Warfare (C2W). The integrated use of OPSEC, military deception, PSYOP, EW, and physical destruction, mutually supported by intelligence, to deny information to, influence, degrade, or destroy adversary C2 capabilities, while protecting friendly C2 capabilities against such actions.

1.3.3 DoD Annual EW Plan. The annual DoD EW Plan compiles EW, tactical cryptologic, and tactical SIGINT technology (multi-year) RDT&E and production plans in the President's annual budget submitted to the Congress. The plan is prepared by the Joint Command and Control Warfare Center (JC2WC), the Services, the Defense Intelligence Agency (DIA), National Security Agency (NSA), and the Joint Staff (JS) under the direction of the Under Secretary of Defense for Acquisition and Technology [USD(A&T)].

1.3.4 T&E Oversight. Programs under OSD T&E oversight are subject to the provisions of the DoD 5000 series which require that each program have a Test and Evaluation Master Plan (TEMP) and that OSD approve the TEMP. The DoD 5000.2-R ~~DoDI 5000.2~~ requires that the DOT&E and the DT&E jointly publish an annual listing of major and other designated defense acquisition programs for OSD T&E oversight. EW

systems under OSD T&E oversight include all ACAT I programs as well as selected ACAT II and III programs.

1.3.5 Annual Report to Congress. A consolidated DoD report on the implementation of this process by DoD Components for those EW systems under OSD T&E oversight will be included in the Annual DoD EW Plan each year. Based on Service program inputs, the Director, Test, Systems Engineering and Evaluation OUSD(A&T), with the Director, Operational Test and Evaluation, will prepare the ~~joint~~DoD annual -report~~ for inclusion in the annual EW plan.~~.

Appendix A contains a list of abbreviations and acronyms used in this document.

Appendix B contains the definition of other significant terms used in this document.

2. THE DOD TEST AND EVALUATION PROCESS FOR EW SYSTEMS

2.1 Overview. A DoD Test and Evaluation (T&E) Process for Electronic Warfare Systems, shown in Figure 1, is a five step iterative process that provides answers to critical EW T&E questions for decision makers to support decisions for each phase of the acquisition process.

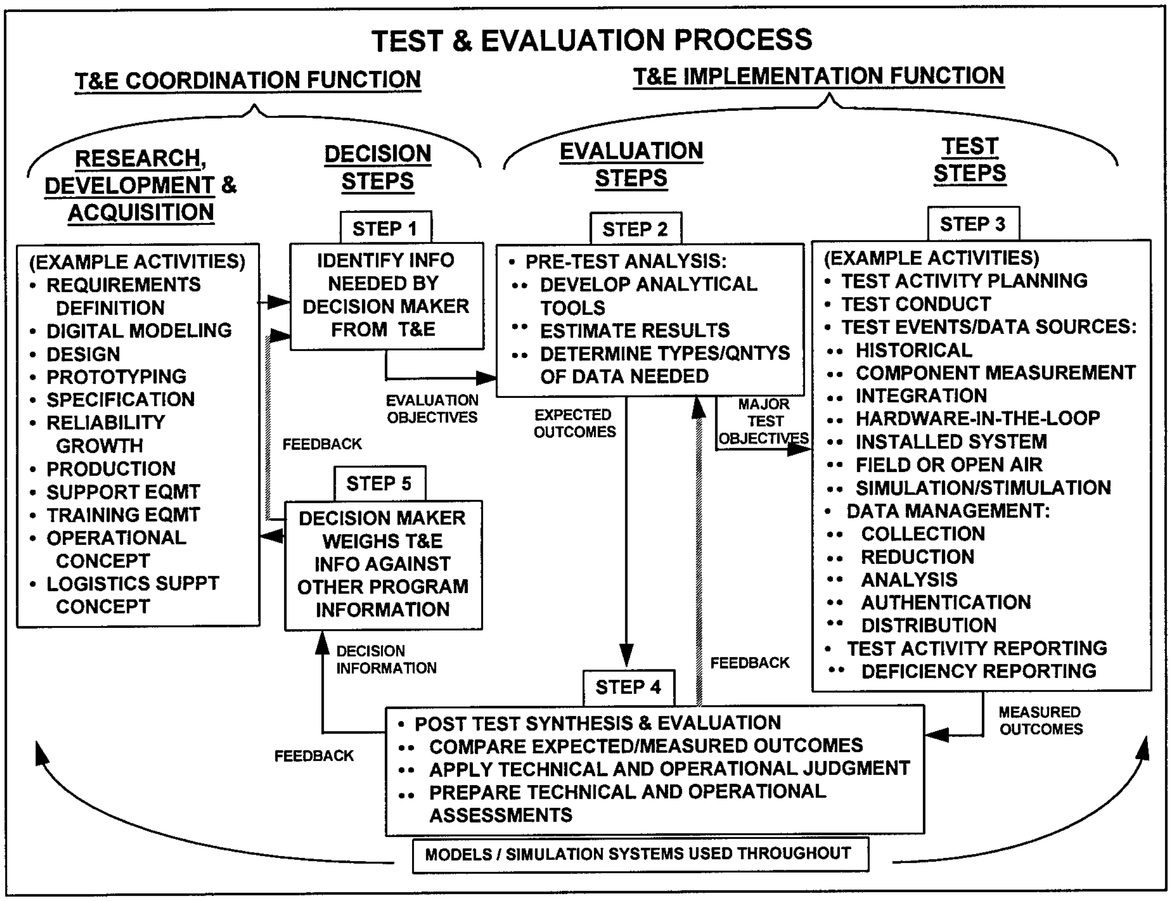

Figure 1. The Five Step T&E Process for EW Systems

The Process is contained within two major functions, the T&E Coordination Function and the T&E Implementation Function. The Process can involve extensive use of modeling and simulation systems. It provides a continuous approach to the problem of managing EW system acquisition during T&E. Detailed feedback is essential throughout the process for successful EW system acquisition. The Process establishes a comprehensive approach to T&E that may be applied one or more times within each of the ~~five~~ four phases of the DoD acquisition process.

The process is structured so that it can be used at any time by any program. Its application and execution are based upon EW T&E information needed by decision makers.

2.2 General. After JROC validation of the mission need (for ACAT 1 and 1A programs), the USD(A&T) convenes a ~~The~~ Milestone 0 (MS 0) Defense Acquisition Board (DAB) to review the ~~decision marks the beginning of the acquisition process with the approval of the M~~mission ~~N~~needs ~~S~~statement (MNS), identify possible materiel alternatives, and authorize concept studies if deemed necessary. The EW MNS defines projected needs for an EW capability in broad operational terms of mission objectives and general capabilities providing a clear military worth. A favorable Milestone 0 decision activates the DoD EW T&E process but does not mean that a new acquisition program has been initiated. ~~The MS 0 decision also identifies the alternative EW concepts or designs to be studied; approves the start of Phase 0 - Concept Exploration and Definition, establishes Phase 0 exit criteria to be evaluated at Milestone I, and activates the DoD T&E Process. Milestone decisions are documented in the Acquisition Decision Memorandum (ADM) for Acquisition Category (ACAT) I EW programs.~~

2.2.1 During each phase and at each milestone, decision makers need information from several sources to determine the best course of action. The information needed from T&E can be summarized as a series of questions to be answered during the process in each phase. The questions are the basis for the T&E process in that phase; and, in this document, they are stated in the context of the Process as they relate to each phase. The outcome of the EW T&E process is technical and operational assessments delivered to the decision maker as answers to those questions.

2.3 T&E Coordination Function. The T&E process for EW systems begins with the T&E Coordination Function, which has three parts: the Research, Development and Acquisition (RDA) Function and Steps One and Five of the Process.

2.3.1 Research, Development and Acquisition (RDA) Function activities are the basis for T&E activities in that the MNS and Operational Requirements Document (ORD) contain the requirements against which the EW system must be evaluated (see examples in Figure 3). Although requirements generation and maintenance are not part of the T&E process, the T&E community should be involved in the generation of these requirements to ensure that identified requirements are testable, measurable and can be evaluated. Other RDA activities that affect T&E range from specification identification through design and development and production to training and support needs. The degree to which each of these has been demonstrated must be considered by decision makers. Answers with regard to the achievement of EW system performance objectives come from T&E. Answers to other questions, such as urgency, military effectiveness, costs and schedules, come from other sources such as Intelligence, Program Analysis and Evaluation (PA&E), Legal, or Comptroller.

2.3.1.1 Successful EW T&E is driven by the operational environment and the military mission that must be accomplished. The dominant measurement of the operational utility is how well the EW system is able to perform its operational mission over time. ~~At MS 0, the user presents the MNS to the Defense Acquisition Board (DAB). If the MNS receives favorable consideration, the DAB authorizes entry into~~

The focus of Phase 0, Concept Exploration, efforts~~ and Definition,~~ is to define and evaluate the feasibility of alternative concepts and to provde a basis for assessing the relative merits (i.e., advantages and disadvantages, degree of risk) of these concepts at the next milestone decision point. An analysis of alternatives is used as appropriate to compare alternative concepts. The most promising system concepts shall be defined in terms of initial, broad, objectives for cost, schedule, performance, software requirements, opportunities for tradeoffs, overall acqusisition strategy, and test and evaluation strategy. Test and evaluation planning shall begin in Phase 0. Both developmental and operational testers shall be involved early to ensure that the test program for the most promising alternative can support the acquisition strategy and to ensure the harmonization of objectives, thresholds, and measures of effectiveness (MOEs) in the ORD and TEMP. Test and evaluation planning shall address MOEs and measures of performance (MOPs) with appropriate quantitative criteria, test event or scenario description, resource requirements (e.g., special instrumentation, test articles, validated threat targets, validated threat simulators and validated threat simulations, actual threat systems or surrogates, and personnel), and identify test limitations.~~from which are formulated the operational suitability and effectiveness parameters and critical technical parameters (CTPs) against which the EW system is tested and evaluated. The objectives of Phase 0 are to explore various materiel alternatives to satisfying the documented mission need, define the most promising system concept(s), develop risk analyses, and develop a proposed acquisition strategy and initial program objective for cost, schedule and performance for the most promising system concept(s). A Cost and Operational Effectiveness Analysis (COEA) and ORD are prepared.~~

As the acquisition process proceeds, the concepts to be studied in Phase 0 are defined and the engineering and production prototypes to be evaluated in Phases I and II are built. In Phase~~s~~ III ~~and IV~~ the EW system, and its modifications if appropriate, must be evaluated.

2.3.1.2 The RDA Function activities list in Figure 2 includes the following:

(EXAMPLE ACTIVITIES)
• REQUIREMENTS DEFINITION
• DIGITAL MODELING
• DESIGN
• PROTOTYPING
• SPECIFICATION
• RELIABILITY GROWTH
• PRODUCTION
• SUPPORT EQMT
• TRAINING EQMT
• OPERATIONAL CONCEPT
• LOGISTICS SUPPT CONCEPT

Figure 2. Example RDA Activities

2.3.1.2.1 Requirements Definition. System requirements evolve from the MNS through the ~~COEA~~ analysis of alternatives and the ORD to the Acquisition Program Baseline (APB) and the Test and Evaluation Master Plan (TEMP). Requirements must be clear, complete, consistent, feasible, and evaluateable. They are derived from military needs and stated as technical and/or operational suitability and effectiveness parameters, e.g., antenna characteristics, component sensitivity, operating spectrum, agility, power levels. The requirements are articulated as objectives and thresholds (see DoD 5000.2-R, Part 2, Page 3), e.g., minimum required jammer effective radiated power (ERP), receiver/transmitter bandwidths, maximum dynamic range. They must be neither wholly qualitative, which allows uncontrolled personal opinion to enter the process, nor wholly quantitative, forcing "failure" of a system that is "good enough" but not perfect. Military needs (in the MNS) and operational requirements (in the ORD) are the criteria used to determine the military worth of a system relative to the military needs.

Operational requirements are a basis for CTPs, used by the developmental T&E (DT&E) program as the basis for its tests. Operational requirements are also a basis for Measures of Effectiveness (MOEs), (e.g., missile miss distances, kill probabilities, detection and tracking ranges), used by the operational T&E (OT&E) agency as the basis for its determination of operational effectiveness and suitability. Measures of Performance (MOPs), derived from MOEs may also be used to support the determination of operational effectiveness and suitability. MOEs and MOPs form the basis for the operational evaluation which, in turn, shapes the operational tests.

2.3.1.2.2 Digital Modeling. Digital models, implemented on computers, are growing in importance, use, and credibility. A digital system model (DSM) is a computer model, or software equivalent, of a system under development. Digital models used in RDA activities may be similar or identical to those used in the T&E Implementation Function, and in fact may be first created during Concept Exploration ~~and Definition~~and updated and used as the EW system proceeds through development and T&E. Models are used during the RDA activity to evaluate concept feasibility, to attempt to define the technical limits of system performance, to allocate requirements and functions, to plan tests, to interpolate test results, and to provide a rigorous

evaluation methodology. These models may be simple thought processes or "back-of-the-envelope" estimates, or they may be sophisticated simulations of system performance. But the causal relationship between military effectiveness and system performance must always be developed, validated and documented.

Those digital models selected for use in the EW T&E process must be appropriately validated and certified. Models and simulations may range in scope from macroscopic, i.e., operational scenarios, threat engagements (many-on-many), and electromagnetic interactions among systems, to a high degree of fidelity (microscopic), i.e., detailed technical representation of electromagnetic propagation and signal processing functions of the system under test (SUT). Any or all of these types of models and simulations may be used to support the process of translating the broad operational capabilities as described in the MNS into system-specific performance requirements that may be demonstrated through T&E.

2.3.1.2.3 Design. System Design is the first step in creating the system. EW system design is the process of converting specifications for an EW capability into a visual or mathematical representation of the system. As the system characteristics take form, it is very important that progress on the system design is communicated effectively to the user to ensure that the new EW capability continues to satisfy the operational requirements. System design is perhaps the most critical step in the RDA function because, once built, the EW system is much more difficult to modify to correct deficiencies built into the original design. Once approved, the design is converted into a prototype (working model). Testing is conducted to assess whether the EW system design meets the requirements.

2.3.1.2.4 Prototyping. Joint Publication 1-02 states that a prototype is a model suitable for evaluation of design, performance, and production potential. For the purpose of this process, prototypes are classified as engineering and production.

2.3.1.2.4.1 Engineering Prototype. An engineering prototype (EP) is a development model of a unit that is close to production. This term may apply to circuitry, a device (black box), or a system, and may be in a breadboard (technical) configuration. EPs are normally used in Phase I.

2.3.1.2.4.2 Production Prototypes (PP). A production prototype is a final model of a design before the pilot unit is approved for production. It should be highly representative of final equipment, except that the exact manufacturing assembly process and production design changes may not yet be used or incorporated. It is suitable for complete evaluation of its electrical and/or mechanical form and may be in a brassboard (technical and operational configuration). PPs are normally used in Phase II.

2.3.1.2.5 Specifications are the values that convert requirements into design terms. They must clearly and accurately relate back to the technical

requirements of the system. An audit trail from the requirements documents to the specifications ensures that the system, when built to the specification, performs as intended.

2.3.1.2.6 Reliability Growth is a process in which the reliability of the operational system improves through identification and correction of systemic reliability failures. During Engineering & Manufacturing Development (EMD), laboratory tests on prototypes are performed to uncover component reliability failures, make design improvements, and project a reliability point estimate. Later, the system is deployed and field data are collected. The validity of this process lies in the activities associated with operational failures. If the user is aggressive in reporting, cataloging and investigating reliability failures, and commits the time and resources to their correction, reliability will, in all likelihood, improve. If these steps are not taken, reliability cannot improve and will probably decrease as the system is subjected to more maintenance than was originally intended.

2.3.1.2.7 Production is the manufacturing of the system after it has been funded, found to be producible, and deemed operationally suitable and effective. The capability and integrity of the manufacturing process to produce systems meeting the system design requirements is evaluated and measured through inspections and testing. The attributes of a producible EW system design are that it can be manufactured economically and with consistent quality. The system design should address the manufacturing facility's variability in material, process, and personnel sources and require that the manufacturing processes be controlled to the level addressed in the design.

2.3.1.2.8 Support Equipment is that category of ancillary "things" necessary to sustain the EW SUT or, during T&E, to support, monitor and record the test. Support equipment includes auxiliary power carts, signal generators, oscilloscopes, video and still cameras, video and audio recorders, stripchart recorders, and numerous other items without which the system could not operate properly or be adequately tested. Support equipment requirements for T&E must be identified in Part V of the TEMP early in the T&E process to ensure availability when needed.

2.3.1.2.9 Training Equipment. Since most new or highly modified systems are somewhat unique, the personnel who use and maintain the system must be retrained to use it properly and safely. Training equipment includes items such as computer workstations, display devices/consoles for troubleshooting, and test bench mockups of the system that either permit that training or are used during training to instruct the operators and maintainers in the correct way to operate and maintain the system.

2.3.1.2.10 Operational Concept. The operational concept, as defined in the ORD, is the planned methodology by which the EW system is to be used and supported during peace and conflict. The ORD provides performance parameters in

terms of operational suitability and effectiveness criteria thresholds and objectives. Understanding the operational concept is critical for both DT&E and OT&E personnel.

2.3.1.2.11 Logistics Support Concept is the plan by which the EW system is maintained. It includes spares, maintenance, transportation, and support personnel requirements. Developing integrated logistics support requirements consistent with readiness objectives, system design and resources should be considered early in the acquisition process.

2.3.2 STEP ONE is the identification of T&E information required by the Milestone decision maker (See Figure 3). The required information consists of performance and effectiveness evaluations of how well the system meets the user's needs. This information progresses from answers concerning proposed alternative EW concepts in Phase 0 to answers on system technical performance and operational suitability and effectiveness during Phase II and beyond.

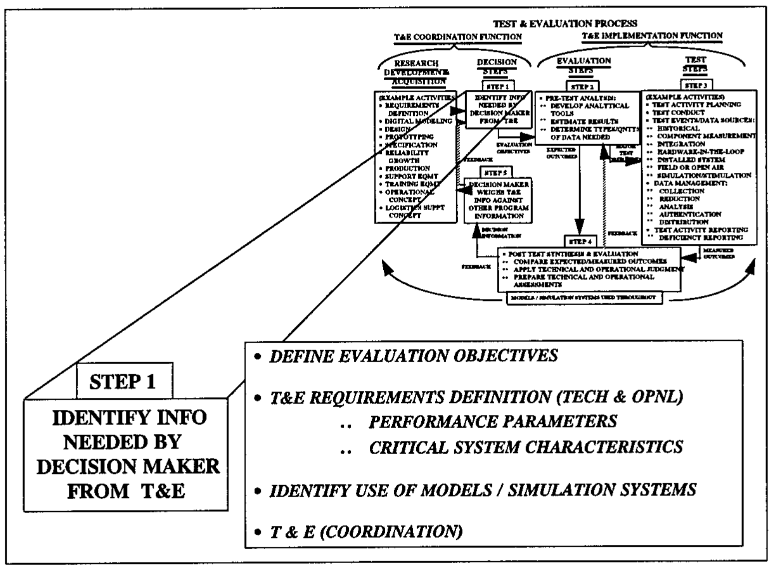

Figure 3. Step One: Identification of Information Needed by Decision Maker

2.3.2.1 The required information usually centers on the current SUT which is in the form of concepts, prototypes, both engineering and production, and/or the system itself depending on the acquisition phase. Step One of the T&E process is initiated by the preceding Milestone decision of the Acquisition Process.

2.3.2.2 Areas in which questions can be expected from the Milestone decision maker in each phase are: the relevance of historical data, accuracy and connectivity of stated requirements, adequacy of T&E infrastructure and technology base, testing alternatives, system performance versus validated threats, projected impact of the system on battle outcomes, capabilities, limitations, feasibility, preferred system, and T&E exit criteria. Association of each question with an acquisition phase is discussed later in the application of the T&E Process to the Acquisition Process. The principal outcome of this Step is the determination of evaluation objectives.

2.3.2.2.1 To ensure that a sound, cost-effective approach is implemented, the T&E resources need to be identified as early in the process as possible--preferably

prior to Step One. As testing proceeds and the system matures, the level of fidelity (accuracy) of required data, of threats and surrogates, and of the test environment increases and costs escalate rapidly. Accordingly, the test manager should carefully weigh the numbers and types of tests, in a cost/benefits analysis, and assess required data that could be acquired through comparatively lower cost modeling and simulation versus data that must be acquired through the more costly field or open-air test events.

2.3.2.3 A Requirements Correlation Matrix (RCM) (similar to the example illustrated in Figure 4) can be used to provide an audit trail of the EW system under development. Such a matrix could include, but not be limited to, a comparison of operational requirements, operational performance parameters, and key system performance parameters. Models and simulations can be used to assist in establishing objective and threshold values which can be displayed in an RCM. The sample RCM identifies operational requirements, operational performance parameters and key system performance parameters. These characteristics and requirements serve as the foundation for development of a System Maturity Matrix (SMM).

2.3.2.4 A System Maturity Matrix (SMM) (similar to the example illustrated in Figure 5) is an acquisition management tool that can be used to highlight differences between the required objective/threshold values and the demonstrated values resulting from scheduled testing. The sample SMM contains key system and technical performance parameter thresholds as appropriate, as well as objectives, at specific points in time within the development process of the system. These specific thresholds are called "exit criteria". The SMM displays these parameters necessary to measure progress toward meeting the operational requirements. At the milestone review points, decisions are made as to the ability of the system to proceed to the next phase in the acquisition process. Exit criteria for critical parameters are requirements so important to the need that, if not satisfied, will result in cancellation or reassessment of the program. The characteristics listed in the SMM will likely be few in number.

Figure 4. Sample Missile Warning System Requirements

	PARAMETER LINKAGE	MILESTONE I OBJECTIVE	MILESTONE II Objectives/ Thresholds	MILESTONE III Objectives/ Thresholds	IOC ASSESSMENT
OPERATIONAL REQUIREMENTS					
1. IMPROVED SITUATIONAL AWARENESS					
2. PROB. OF SURV. OCA SCENARIO		.98			
OPERATIONAL PERFORMANCE PARAMETERS					
A. DETECT INCOMING MISSILES	1, 2	.99	THRESHOLD ESTABLISHED AT MILESTONE II	THRESHOLD REFINED AT MILESTONE III	
B. DISCRIMINATE MISSILE TYPES	1, 2	TOP 10			
C. TRIGGER CM OR MANEUVER	2	.99			
D. LOW FAILURE	1, 2	.95			
KEY SYSTEM PERFORMANCE PARAMETERS					
1. PROBABILITY OF DETECTION	A	.99	THRESHOLD ESTABLISHED AT MILESTONE II	THRESHOLD REFINED AT MILESTONE III	N/A
2. DETECTION RANGE	A	10 NM			
3. FALSE ALARM RATE	B	TBD			
4. ANGLE OF ARRIVAL ACCURACY	B, C	10 DEG			
5. TIME TO GO	C	TBD			
6. TARGET PRIORITIZATION CAPABILITY	B	TOP 10			
7. MULTIPLE THREAT CAPABILITY	B, C	5			

Correlation Matrix (RCM)

As the EW system progresses/matures, sub-elements or new characteristics may be added to these matrices. A critical characteristic is a requirement so important to the need that, if not achieved, will result in cancellation or reassessment of a program. A threshold is, therefore, the value a critical characteristic must meet. It becomes an exit criterion when coupled with a specific point in time (a particular milestone or decision point) when it must be attained. Objectives are requirements, although not critical, that represent user desires or potential improvement above thresholds. After T&E requirements have been identified and are considered measurable, pre-test analysis is performed before actual testing begins.

2.3.3 STEP FIVE (See Figure 6) is where the decision maker weighs the T&E information against other programmatic information to decide a proper course of action. The decision will be based on criteria of military worth, as well as consideration of cost, funding, urgency, etc. When associated with an acquisition milestone, this decision is announced in an Acquisition Decision Memorandum (ADM) which outlines the future course of action for the program and the SUT. Additionally, each milestone decision contains the "exit criteria" for the next Phase/Milestone.

	PARAMETER LINKAGE	MILESTONE I OBJECTIVE	MILESTONE II Objectives/ Thresholds	MILESTONE III Objectives/ Thresholds	OT&E CRITERIA	PREDICTED VALUE	DEMONSTRATED VALUE/PHASE
KEY SYSTEM PERFORMANCE PARAMETERS							
1. PROBABILITY OF DETECTION	A	.99	THRESHOLD ESTABLISHED AT MILESTONE II	THRESHOLD REFINED AT MILESTONE III			OT&E
2. DETECTION RANGE	A	10 NM					
3. FALSE ALARM RATE	B	TBD					
4. ANGLE OF ARRIVAL ACCURACY	B, C	10 DEG					
5. TIME TO GO	C	TBD					
6. TARGET PRIORITIZATION CAPABILITY	B	TOP 10					
7. MULTIPLE THREAT CAPABILITY	B, C	5					
TECHNICAL PERFORMANCE PARAMETERS							
a. FIELD OF VIEW	1, 2	NORMALLY NOT SPECIFIED UNTIL MILESTONE II	OBJECTIVE ESTABLISHED AT MILESTONE II	THRESHOLD ESTABLISHED AT MILESTONE III	N/A		DT&E
b. SPECTRAL SENSITIVITY	1, 2, 3						
c. SPECTRAL COVERAGE	1, 2, 3						
d. SPATIAL RESOLUTION	1, 4						
e. S/N RATIO	3						
f. BANDPASS	1, 3						
g. SIGNAL THRU-PUT	7						
h. PROCESSING CAPACITY	5, 7						
i. MIN RESOLVABLE TEMPERATURE	B						
j. CM INTERFACE	C						
k. MTBF, MTTR	D						
l. BUILT-IN-TEST SUPPORTABILITY	D						

Figure 5. Sample Missile Warning System Maturity Matrix (SMM)

2.3.4 Feedback. It is possible that the decision maker asked the wrong question or that the questions were misunderstood by the T&E community. The decision maker should compare the information contained in the assessments with the questions previously asked to ensure that the responses are adequate. Problems should be highlighted and resolved. The decision maker can then rephrase succeeding questions to ensure better understanding of the information needed.

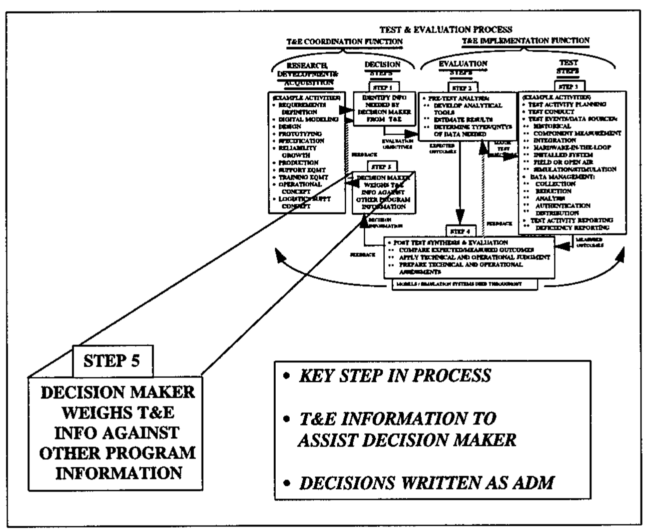

Figure 6. Step Five: Decision Maker Weighs the T&E Information Against Other Program Information

2.4 T&E Implementation Function. The test and evaluation implementation function encompasses the three steps necessary to develop the information needed to prepare the assessments used by decision makers in Step Five.

2.4.1 STEP TWO (See Figure 7) is the pre-test analysis of the evaluation objectives from Step One to determine the types and quantities of data needed, the results expected or anticipated from the tests, and the analytical tools needed to conduct the tests and evaluations.

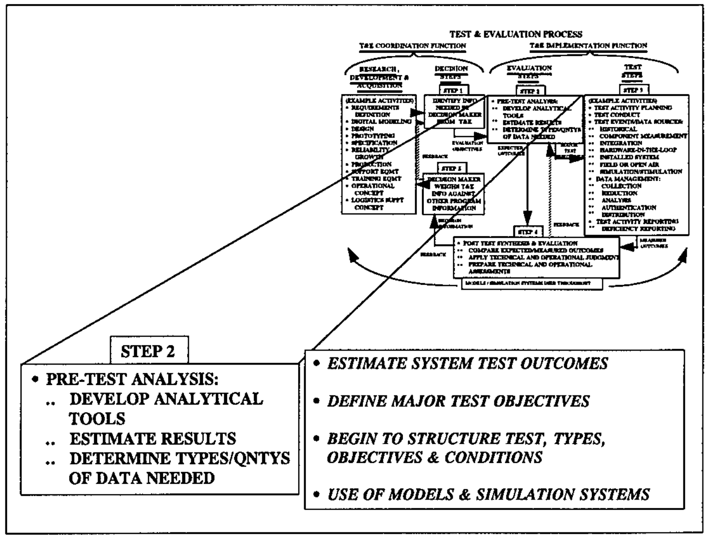

Figure 7. Step Two: Pre-Test Analysis

2.4.1.1 Pre-test analysis develops the analytical tools, allocates test parameters to requirements, estimates test results, determines the types and quantities of data needed, and identifies the major test objectives.

2.4.1.2 The use of validated models and simulation systems during pre-test analysis can aid in determining: 1) how to design test scenario(s), 2) how to set-up the test environment, 3) how to properly instrument the test, 4) how to man and control the test resources, 5) how best to sequence the test trials, and 6) how to estimate outcomes. In this step, models and simulations are used to estimate test results.

2.4.1.3 The end product of this step is the expected outcome of the system under test. When a determination is made that additional data are necessary and major test objectives are identified, the process moves to Step Three.

2.4.2 STEP THREE, test activity and data management, (See Figure 8) is the actual test activity planning, test conduct, and data management practices. Given the data requirements from Step Two, T&E managers determine what valid data exist in historical files that can be applied to the SUT and what new data must be developed from test events. They plan and execute the tests necessary to develop the data. The historical and developed

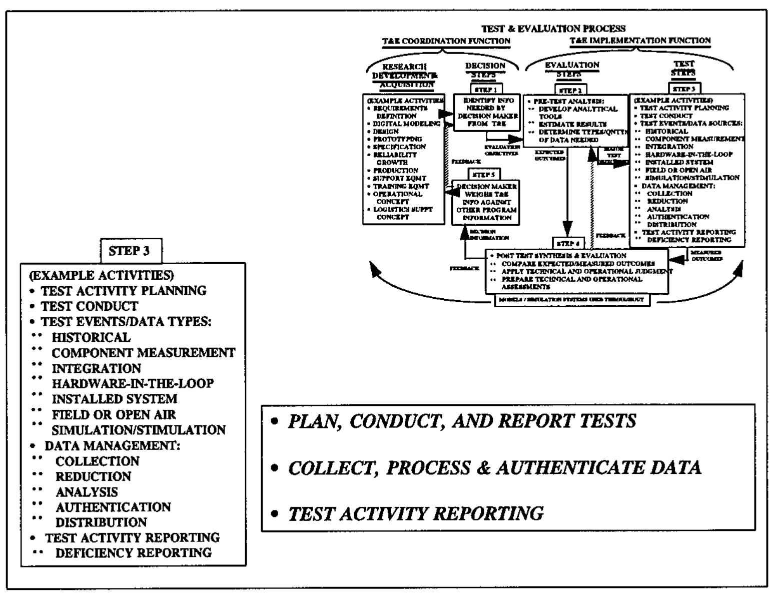

Figure 8. Step Three: Test Activity and Data Management

data are reviewed for completeness and accuracy, authenticated, and forwarded to Step Four for assessment as measured outcomes.

2.4.2.1 Test activity planning includes gathering the required test articles and test support equipment, scheduling facilities and identifying the climatic, mission and threat environments.

2.4.2.2 Test conduct uses the EW T&E capabilities infrastructure and is the culmination of test activity planning and, with the exception of historical data, is the execution of the actual test events. As shown in Figure 8, test activities range from historical searches of the performance of like or similar components, subsystems and systems to actual hardware tests of component incoming parts through multi-system, open-air, operationally realistic "free-play" scenarios. Data gathered during the test, or from historical searches, are input to the data management activity for processing.

The Reliance Study defines EW T&E capabilities as those resources used for the evaluation of electronic countermeasures (ECM); electronic counter-countermeasures (ECCM); suppression of enemy air defense (SEAD); and command, control, communications, and intelligence (C3I) components, subsystems, systems, and EW functions of federated or integrated avionic/vetronic suites. EW testing includes operational test considerations for missions and warfighting requirements of the Army, Navy, Air Force and Marine Corps and involves evaluation of their vehicles and EW equipment for required performance, mutual interference, and detectability by the enemy.

2.4.2.2.1 Historical Test Data. The initial step in any EW test activity should be the examination of previous test data (or descriptive summaries) stored in historical archives to ascertain the utility of previous test results, i.e., does the required new EW capability share sufficient commonality with any predecessor system such that some testing can be obviated. Component, subsystem and system data from like or similar components, subsystems or systems must be examined first for applicability, and, if applicable, to reduce the amount and/or type of hardware/software testing necessary for evaluation. Further, modeling and simulation of historical test data, in lieu of actual testing of the current SUT, should be performed to fill historical information voids. This is a highly cost effective procedure that leads to the determination of what data are lacking and needed from new test and evaluation events.

2.4.2.2.2 Component Measurement Test Events often involve the use of specialized capabilities to explore and evaluate advanced technologies, e.g., Microwave Monolithic Integrated Circuits (MMIC), Very-high-speed ICs (VHSIC), Microwave Power Modules (MPM), Digital RF Memory ~~devices~~ (DRFM)~~,~~ devices, Acoustic Charge Transport (ACT), and are usually the first test events performed during the development and/or buildup of the system. Examples include incoming parts inspection, thermal, acoustic and vibration cycling, power requirement, and heat generation tests. For EW systems, measurement resources provide those specialized

capabilities cited above. They generally fall into the sub-categories of antenna measurement, RCS measurement, infrared (IR)/laser signature measurement, and electromagnetic interference/compatibility (EMI/EMC) test capabilities.

2.4.2.2.3 Integration Test Events test EW components, subsystems and systems combined with other elements. The other elements may be other parts of the same system or different systems altogether with which the SUT must operate. These tests are used to evaluate individual hardware and software interactions with each other and with the entire avionic/vetronic suite and are frequently conducted in integration laboratories specifically designed to test the SUT integrated with other systems or functions. Integration laboratories are generally weapon system specific (except for associated environment generators) and are used from the beginning of an EW system's development through avionics/vetronics integration and fielding. These laboratories often employ a variety of digital models, simulations, and stimulations to generate scenarios and electromagnetic backgrounds at or near real time.

2.4.2.2.4 Hardware-in-the-loop (HITL) Events. HITL tests use elements of the SUT in combination with software to examine the performance of those elements before the entire system is available or when a specific capability cannot be tested. For EW systems, these events are conducted indoors in a secure environment to test the systems against manned, closed-loop, and open-loop threat simulators. These tests provide unique opportunities to evaluate EW systems hardware at different stages of development (e.g., breadboard, brassboard, prototype, or production), possibly years before the host platform is available, thereby facilitating concurrent development of the EW systems or functions, other systems, and the platforms/vehicles themselves. HITL testing also allows production systems to be tested under controlled and repeatable test conditions, thus providing an inexpensive complement to flight testing. Additionally, the controlled environment readily lends itself to EW technique optimization and closed-loop operational effectiveness evaluation.

2.4.2.2.5 Installed Systems Test Events provide capabilities to evaluate SUTs and functions that are installed on and integrated with their host platforms. These tests can occur in indoor facilities such as EW anechoic chambers, in which free-space radiation measurements are made during simultaneous operation of the EW system and other host platform systems, or climatic chambers or as outdoor DT and OT tests. Chambers provide secure sites to evaluate the capabilities and limitations of the system against simulated and stimulated inputs. In an anechoic chamber, for example, the SUT is stimulated by threat signal generators and its responses are evaluated to provide critical information regarding integrated system performance. Climatic chambers permit examination of SUT capabilities in varied climatic conditions ~~climates~~ without having to transport the SUT to those naturally occurring climates.

2.4.2.2.6 Field or Open Air Test Events. The term "field test" or open air test refers to any test conducted outdoors. It includes surface (land and sea), undersea, airborne and spaceborne testing. Field tests are conducted where it is

feasible, safe, and secure to test all or part of the SUT in an environment that is normally more realistic than any attainable indoors. Field tests may allow the SUT to be operated more closely to its operational conditions.

2.4.2.2.6.1 The Reliance Study has divided open air test resources into two subcategories: EW test ranges and airborne testbeds. 1) Open air EW test ranges are highly instrumented facilities with high fidelity threat simulators and real systems, and are primarily used to test systems and functions installed either in a testbed or the intended host aircraft/vehicle. Open air testing provides the most operationally realistic environment in which to evaluate a SUT. Real world phenomena encountered during range testing include terrain effects, multipath propagation, electromagnetic interference (EMI) effects, etc. 2) Airborne testbeds are normally large airframes designed for spread-bench installation and testing of EW and other avionics systems. They permit flight testing of EW techniques, components, subsystems, systems, or entire avionics suites in their early stages of development and/or modification, often prior to the availability of prototype or production hardware.

2.4.2.2.7 Simulation/Stimulation Events. Simulation and stimulation events are used extensively in the DoD test process. They can be applied to computer or physical working models or the SUT. They may be real time or non-real time models. Effective use of credible models and their simulation/stimulation events provides cost effective T&E.

2.4.2.2.7.1 According to the EW T&E Reliance Study, digital models and computer simulations represent EW systems, host platforms, other friendly players, the combat environment, and threat systems. These models run interactively in real or simulated time and space domains, along with other factors of a combat environment. Specific computer simulations are constructed at various levels of detail, corresponding to the level of technical complexity they support (i.e., engineering, platform, mission, or campaign). Presently, there are numerous computer simulations in use (e.g., AASPEM, SUPPRESSOR, ALARM, and Enhanced SAMS); however, they do not share a common architecture. For example, AASPEM, the Advanced Air-to-Air System Performance Evaluation Model, models air-to-air engagements, including beyond-visual-range maneuvering; close-in-combat air-to-air tactics; sensor detection and tracking; missile lock-on, launch, fly-out, firing, detonation, and kill; gun firing; laser firing; and defensive reaction to weapons while ALARM, the Advanced Low Altitude Radar Model, is a radar-range-equation-based detection model that includes the effects of ground clutter, terrain masking, multipath, diffraction, atmospheric attenuation and jamming against several types of radar systems, e.g., MTI, pulse Doppler, and CW. While both of these examples describe very complex models that possess a high degree of specificity, their purpose and use in the T&E process would be for very different reasons and probably at different phases in the Acquisition process, i.e., ALARM would appear to be more appropriate for assessing technical performance while AASPEM would likely be used closer to OT&E to assess operational performance.

2.4.2.2.7.2 A greater capability to simulate existing and planned military systems and the threats they are designed to counter is needed. The Joint Modeling and Simulation System (J-MASS) program is addressing these problems and should be contacted for use of their standard modeling architecture and simulation support.

2.4.2.3 Data Management. Data recorded during test events are often not in a form best suited for analysis. Several steps are taken to make the data more usable:

2.4.2.3.1 Data Collection and Reduction. Most data are recorded "raw" and scaled to match the recording capabilities of the analog or digital recording system without regard to the actual magnitude of the data. This first step in the data management process is assembling data from all sources and reducing them to engineering values.

2.4.2.3.2 Analysis and authentication ensures that all data accurately reflect the operation of the SUT. Data from multiple sources are compared for agreement, data dropouts are filled in where possible and questionable data are compared with other sources for reasonableness. The data are then distributed for further use in the synthesis and evaluation step.

2.4.2.4 Deficiency Reporting is the process of formally documenting failures to meet required performance thresholds or objectives, human factors limitations, safety concerns, etc. Deficiency reports are forwarded to the program office for correction. Procedures for deficiency reporting differ among the Services, but because of the critical importance of deficiency reporting during field testing, it should in all cases be a clearly defined, formal process. Evaluation of the impact of the deficiency on suitability and effectiveness must be part of the deficiency reporting process. Merely quoting specifications as a justification for submitting a deficiency report may lead to costly, time-consuming changes that are not operationally required or that preclude making other, more valuable changes. For example, the evaluators should assess how the deficiency affects operational mission accomplishment. Does the deficiency require more spares, more manpower, or longer down times than can be afforded in a military operation? And finally, can the user work around these limitations and make effective use of the system?

2.4.2.5 The end product of this step is measured outcomes in the form of T&E activity reports which are provided to the analysts for Step Four.

2.4.3 STEP FOUR, post test synthesis and evaluation, is the combination of the measured outcomes of Step Three with the expected outcomes from Step Two, tempered with technical and operational judgment. The output of Step Four is the answers to the questions developed at Step One. See Figure 9.

2.4.3.1 When measured outcomes differ from expected outcomes, the test conditions and procedures must be reexamined to determine if the deviations are real, that is, due to unexpected performance of the SUT, or are caused by test limitations such as a lack of fidelity in computer simulation, non-availability of support assets, or less than full system availability. If the differences are due to test limitations, the effect of the limitations must be evaluated, if possible, and judgment used to estimate true system performance. However, since this may involve extrapolation of test data, it is inherently risky. Despite the additional cost and time, retesting is usually prudent.

In this step, models and simulations are normally used to process test data and to evaluate system performance and effectiveness using data obtained from the tests. The assumptions of tactics, environment, system performance, and support must be carefully chosen and fully described and documented.

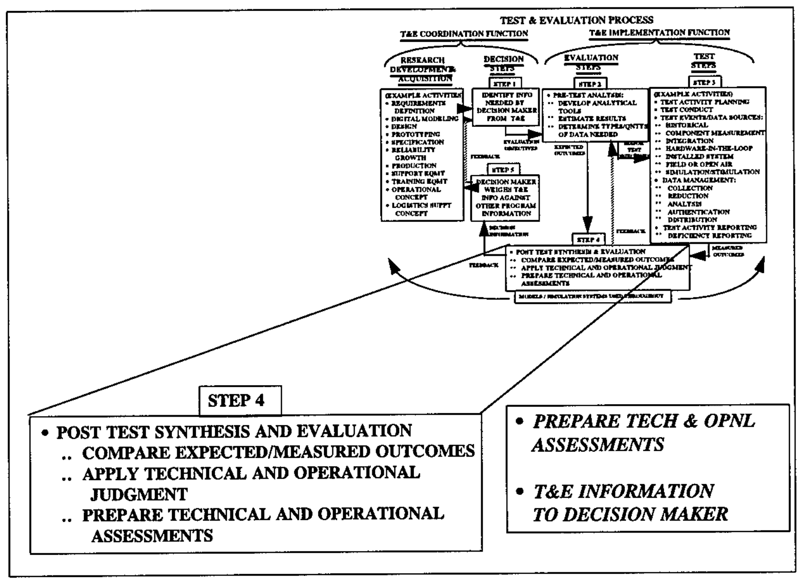

Figure 9. Step Four: Post Test Synthesis and Evaluation

2.4.4 Feedback. As with the decision maker, feedback is necessary within the T&E process to ensure the quality of the output. But unlike the decision maker, who needs to know whether the questions have been answered satisfactorily, here the evaluators must ensure that the data are sufficient to answer the questions posed by (or as understood from) the decision maker. Their satisfaction with the test report data must be transmitted as feedback to the persons responsible for the pre-test analysis to ensure that both the current test and the process itself are as complete, effective and efficient as possible.

This step concludes with the preparation of technical and operational assessments which answer the questions from the decision maker at Step One.

2.4.5 The T&E process concludes at STEP FIVE, as noted above, where the decision maker weighs the T&E information against other program information and assesses the progress of the EW SUT.

3. EW SYSTEMS T&E DURING PHASE 0 - CONCEPT EXPLORATION~~ AND DEFINITION~~ (CE~~&D~~)

3.0.1 Milestone 0-Concept Studies Approval. The Milestone (MS) 0 decision begins Phase 0 in which alternative EW concepts are to be explored to identify the most promising potential solution(s) to validated user needs. T&E concerns at MS 0 are data that can be developed during Phase 0 that support a MS I decision with respect to the alternative concepts and the development of recommended T&E "exit criteria" that are established and presented in the MS 0 Acquisition Decision Memorandum (ADM).

3.0.2 Phase 0-Concept Exploration~~and Definition~~.

3.0.2.1 Phase Description. Phase 0 typically consists of competitive, parallel short-term concept studies. The focus of these efforts is to define and evaluate the feasibility of alternative concepts and to provide a basis for assessing the relative merits (i. e. advantages and disadvantages, degree of risk) of these concepts at the next milestone decision point. Analysis of alternatives shall be used as appropriate to facilitate comparisons of alternative concepts. The most promising system concepts shall be defined in terms of initial, broad objectives for cost, schedule, performance, software requirements, opportunities for tradeoffs, overall acquisition strategy, and test and evaluation strategy.

3.0.2.2 T&E. The main objective of T&E in this phase is to assist in defining and selecting a preferred EW System concept, candidate technologies, and critical operational characteristics.

3.0.2.2.1 Developmental Test and Evaluation. DT&E comprises the major test events and evaluation actions within this phase. The primary purpose of DT&E at this point is to determine whether the proposed EW concepts are feasible. Alternative concepts are analyzed against required key technical and operational performance parameters, e.g., is nanosecond response time required or will microsecond response time suffice? Test resources and tools required to support test and evaluation of any new EW system that may be developed are identified. At this juncture within most EW programs, because there is usually little EW hardware to test at this stage, much of the studies, analyses, concept comparisons, design work, and performance appraisals are done through the use of modeling and simulation. In some cases, however, as a result of an Advanced Technology Demonstration (ATD) program, a brassboard or breadboard may be available for testing. Considerable testing of concepts and some testing of subsystems occurs in this phase.

3.0.2.2.2 Operational Test and Evaluation. Significant OT&E will not likely occur during this phase. The emphasis in this phase is in proving out the particular concept and developing cost effective alternatives that meet the user's needs. To that end, the Operational Test Agency (OTA) reviews program documentation and develops a working relationship with the user in order to understand the operational

requirements and define the critical issues. The OTA will, as a minimum, prepare an initial OT&E outline and participate in acquisition planning to ensure that schedules and long-lead items meet OT&E objectives. The OTA may be required to prepare an early operational assessment (EOA) of critical systems, subsystems, and components may be necessary to ascertain that risk and operating environment are within acceptable limits.

3.1 STEP ONE. Identify Information Needed by Decision Makers from T&E. As a minimum, T&E addresses the (generic) questions as depicted in Figure 10 and, more specifically as listed below as they might relate to each EW concept or concept comparison:

(1) What T&E data exist, e.g., are there historical test data available on previous EW concepts, jammer systems, ECM techniques, etc. that would preclude "reinventing the wheel"? Does preliminary analysis conclude that the concept(s) will work? What is the confidence level in this assessment? Do the available historical data on the testing of platform self-protection, for example, enhance the confidence that an evolutionary, rather than revolutionary, approach is preferred?

> **Phase 0 - Concept Exploration and Definition**
>
> For each concept,
>
> (1) What T&E data exist? Does analysis conclude that the concept(s) will work? What is the confidence level in this assessment?
>
> (2) Can requirements, as stated, be evaluated?
>
> (3) Does the existing T&E infrastructure/technology base permit evaluation? Approximately what is the cost and time frame? If not, approximately what is the cost and time frame to create the infrastructure/technology base?
>
> (4) What are concept(s) capabilities/limitations versus threats?
>
> (5) How can T&E favorably impact risk management or risk reduction?
>
> (6) What alternatives exist to testing/test assets? What are the risks?
>
> (7) Has the preliminary TEMP been approved? Are the critical technical parameters, the minimum acceptable operational requirements, and the critical system characteristics included?
>
> (8) Is each proposed concept feasible? Is one concept preferred?
>
> (9) What are the recommended Phase I T&E "exit criteria"?
>
> (10) Does the Early Operational Assessment (EOA) address the availability of and planning for resources projected for OT&E test events.

Figure 10. Phase 0 T&E Questions

(2) Can requirements, as stated, be evaluated?

(3) Does the existing EW T&E infrastructure/technology base permit evaluation? Approximately what is the cost and time frame? If not, approximately what is the cost and time frame to create the infrastructure and technology base to adequately assess the EW concept(s)? Does the existing technology base support concurrent, rather than sequential, testing of parallel technologies?

(4) What are concept(s) capabilities and limitations versus threats, e.g. does the ECM concept adequately address the monopulse radar threat?

(5) How can T&E favorably impact risk management or risk reduction?

(6) What alternatives exist to testing/test assets? What are the risks associated with using the alternatives?

(7) Has the preliminary TEMP been approved? Are the critical technical parameters, the minimum acceptable operational requirements, and the critical system characteristics included?

(8) Is each proposed EW concept feasible? Is one concept preferred, e.g., does an onboard EW system provide more or less survivability of the host platform than an integrated onboard/offboard system?

(9) What are the recommended Phase I T&E "exit criteria"?

(10) If an EOA is initiated by the OTA at this stage, does it address resource availability and planning for projected OT&E test events?

3.2 STEP TWO. Pre-test Analysis. Pre-test Analysis in EW CE~~&D~~ places maximum emphasis on the development of expected outcomes after determining the major types of tests needed, i.e., open-loop or closed loop, HITL, integration laboratory, flying testbed, open air or range. Among the analytical tools developed during pre-test analysis are digital models and simulations of elements of contending EW concepts that are sufficiently representative of the SUT to permit conceptual design trade-off studies. Conducting pre-test analysis assists in structuring test conditions prior to the conduct of test events. The expected response of the SUT can be used to design test trials to evaluate system effectiveness and suitability. For the initial test set-up, test requirements are derived from the system development and engineering activities.

3.3 STEP THREE. Test Activity and Data Management. This step emphasizes a testing approach to prove out the feasibility of alternative EW concepts. Test planning involves preparation of the acquisition program baseline (APB), the preliminary TEMP and an initial OT&E outline. The actual tests should be structured to provide data for evaluation of acquisition risk and decision making. Testing in the CE~~&D~~ phase is conducted to determine whether the alternative EW concepts can meet the operational need, e.g., can the missile warning system meet, or exceed, the capability to discriminate among at least the top 10 (in priority) threat missiles against which it is designed to operate. Alternative concepts are tested against the requirements outlined in the ORD and APB, and listed in the RCM for tracking. Test events are conducted at facilities commensurate with EW T&E capabilities required for that event. In the CE~~&D~~ Phase the following may be considered.

Historical Test Data. The initial step in any EW test activity should be the examination of previous test data (or descriptive summaries) stored in historical archives to ascertain the utility of previous test results, i.e., does the required new EW capability share sufficient commonality with any predecessor system such that some

testing can be obviated. Development planning agencies, Service analysis agencies (like the Air Force Center for Technology), and hardware contractors should be consulted when researching available system or subsystem historical data bases or data bases that should share data at military laboratories. The use of TECNET, INTERNET, Worldwide WEB, and USENET are suggested for access to repositories of EW data. A thorough search of available test data sources could reduce the cost of the T&E program planned for the potential new system. Further, modeling and simulation of historical test data, in lieu of actual testing of the current SUT, should be performed to fill historical information voids. This is a highly cost effective procedure that leads to the determination of what data are lacking and needed from new test and evaluation events.

Component measurement test events are less likely to occur during this phase than in subsequent phases. However, in some cases actual equipment in brassboard or prototype configurations may be available for measurement test events.

Integration testing may be used to verify fairly complex concepts that require sensor fusion (to perform a more accurate Electronic Support function such as precision emitter location, for example) or that have operator displays and operator actions that need to be evaluated with real time, man-in-the-loop simulations. Emphasis should be on lessons learned and their integration with data available from computer simulations. Test efforts should make efficient use of computer simulation such that sufficient pre-test analysis can be accomplished on those results expected from the actual laboratory testing. This allows comparison of measured results with expected outcomes to validate desired test conditions.

Hardware-in-the-Loop testing is important in this phase in determining the feasibility of each EW concept under test and in evaluating its military worth. That is, what is the value added by the implementation of the EW concept? For concepts that have matured to a hardware stage, HITL test events can be used to refine designs, check system performance in operational environments, and work out early problems by using either flexible, generic EW simulators/stimulators or commercial laboratory equipment, such as oscilloscopes, synthesizers, spectrum analyzers, signal generators, etc.

Installed System Test (IST) Events may not be conducted because few concepts will have reached the installation stage by this Phase. If possible, however, IST events are used to look for optimum solutions to stated needs.

Field/Open Air Tests may or may not be conducted during this phase depending on the availability of prototype hardware. If, however, advanced technology development (ATD) programs have produced brassboard hardware, it may be installed in testbeds to conduct field testing. Data may be obtained in this manner to check equipment operation and help verify non-real-time computer simulations from the CE~~&D~~ phase.

Simulation/Stimulation Events. Simulation and stimulation events are used extensively in the DoD test process. They can be applied to computer or physical working models or the SUT. They may be real time or non-real time models. Effective use of credible models and their simulation/stimulation events provides cost effective T&E. Candidate system concepts to provide the needed mission capability can be analyzed using computer simulations of mission scenarios integrated with models of the system concepts. The use of ALARM (described in paragraph 2.4.2.2.7.1), or a similar model, during this phase should be considered. ALARM is appropriate for assessing technical characteristics.

Data management occurs during this phase. In this step, the data on each EW concept are converted from raw data collected by the testers into measured outcomes which are analyzed for validity and then authenticated.

3.4 STEP FOUR. Post-test Synthesis and Evaluation directly identifies the performance capabilities of the EW system. In the CE~~&D~~ phase, the alternatives ~~concepts~~ identified in the analysis of alternatives~~COEA~~ are judged according to their merit in meeting military needs as stated in the MNS and users' requirements as stated in the ORD. Assessments identify the MOPs for the systems as well as any shortcomings/deficiencies. The measured outcomes of the tests are compared to the expected outcomes established in Step Two. In this phase the greatest disparity between expected and measured outcomes occurs. Measured outcomes of testing, when coupled with expected results from computer simulation, provide the added benefit of refining the simulations and models and updating their parameters in order to better validate the model's accuracy. At the conclusion of the post test synthesis and evaluation step, all test objectives will have been analyzed and demonstrated values will have been documented. The final output of this step must be T&E information for the decision makers concerning the performance parameters, the feasibility of each alternative EW concept, the availability of EW test resources, and the adequacy of the technology base to support the desired concept.

3.5 STEP FIVE. Decision Maker Weighs T&E Information Against Other Program Information. The output of this step is an informed decision on the proper course of action to be taken at this point predicated upon the information received by the decision maker from the application of the Process to date.

3.5.1 Milestone I Decision Point. The results of the Concept Exploration ~~and Definition~~Phase are reviewed and approved by the Milestone Decision Authority (MDA). During this review, the MDA confirms that study efforts support the need for a new program, that the system concept(s) shows evidence of satisfying the requirements, that the threat assessment has been validated as required, that the proposed EW concept is producible and affordable, that risks are manageable, and that adequate resources, including T&E resources, can be programmed to support an acquisition program.

The ADM documents the decision to initiate an acquisition program and enter into Phase ~~I~~I, Program Definition and Risk Reduction ~~(DEMVAL)~~. It also approves the Concept Baseline that was established through the analysis of the alterative EW system concepts. Program-specific exit criteria that must be met during ~~the DEMVAL~~ Phase I are established.

—3.5.2 Documentation. The MDA may require any or all of the following documents be prepared/updated at Milestone I~~following describes the program documentation required by DoD Instruction 5000.2~~: 1) The STA~~R~~ is the primary threat document from which critical intelligence parameters are determined. It is initially prepared and approved by the appropriate Intelligence Agency and validated by the Defense Intelligence Agency (DIA); 2) The ORD is initially prepared in this phase by the user or the user's representative. The ORD reflects the critical operational issues (COIs) and their criteria from which the minimum acceptable operational performance requirements are derived; 3) An analysis of alternatives may be initially prepared at MS 0 and updated at MS I. Significant here are any changes in performance parameters or any adjustment of concepts.~~(Ed see 5) below)~~ ~~The IPS is prepared at MS I. It summarizes the results of Phase 0. It shall identify the most promising concept(s) to be carried into Phase I and the reasons for elimination of alterative concepts; 4)~~

A preliminary TEMP containing the requirements for T&E, the initial management responsibilities, an outline of DT&E and OT&E, and resource requirements must be ~~is~~ prepared. This is the primary T&E document for review authorities.~~; and 5) A COEA is initially prepared at MS 0 and updated at MS I. Significant here is any change in performance parameters or any adjustment of concepts.~~

4. EW SYSTEMS T&E DURING PHASE I –PROGRAM DEFINITION AND RISK REDUCTION ~~DEMONSTRATION AND VALIDATION (DEM/VAL)~~

4.0.1 Milestone I-Concept Demonstration Approval. The MS I decision, rendered in an ADM, determines if the results of Phase 0 warrant establishing a new acquisition program, selects the preferred EW concept(s) to continue development, and approves entry into Phase I. This concept(s) will evolve into engineering prototypes (EPs) for continued T&E. The T&E outcome is the assessment of each EP.

4.0.2 EW Systems in Phase I ~~— DEM/VAL~~.

4.0.2.1 Phase Description. During this phase, the program becomes defined as one or more concepts, design approaches, and/or parallel technologies are pursued as warranted. Assessments of the advantages and disadvantages of alternative concepts are refined. Prototyping, demonstrations, and early operational assessments are considered and included as necessary to reduce risk so that technology, manufacturing, and support risks are well in hand before the next decision point. Cost drivers, life-cycle cost estimates, cost-performance trades, interoperability, and acquisition strategy alternatives are considered to include evolutionary and incremental software development

4.0.2.2 T&E in Phase I ~~DEM/VAL~~. Because Phase I~~DEM/VAL~~ occurs early in the EW T&E process, tests and evaluations may be conducted to validate and qualify the design and to ensure that the product is ready for Government acceptance. Special emphasis should be placed on the use of HITL test events to test systems rigorously in a design exploration and/or refinement effort prior to Government validation testing.

4.0.2.2.1 Developmental Test and Evaluation. DT&E conducted during Phase I ~~the DEM/VAL phase~~ is used to demonstrate: 1) that technical risk areas have been identified and reduced to acceptable levels; and 2) that the best technical approaches have been adopted ~~accepted; and 3) that from this point on, engineering efforts, rather than experimental efforts, are required~~. DT&E supports the MS II decision which considers entry into Full-Scale Development and, as appropriate, low rate initial production (LRIP). An EP can be built in this Phase by replacing certain components in the DSM with hardware components developed during the phase.~~DEM/~~

4.0.2.2.2 Operational Test and Evaluation. OT&E for EW systems during Phase I~~the DEM/VAL phase~~ is conducted to support the MS-II decision regarding a system's readiness to move into Engineering and Manufacturing~~Full-Scale~~ Development. As part of OT&E planning, the operational aspects of the proposed technical approach are examined by the OTA. Consistent with the evolutionary requirements definition, the OTA works with the user to refine proposed performance objectives and identify surge and mobilization requirements. Also, evaluation criteria should be documented and the test schedule reviewed for adequacy of time and that the availability of test articles is sufficient to meet the OT&E objectives. This may include

provisions for an Early Operational Assessment (EOA). If the MS II decision includes an LRIP, an EOA is required.

4.1 STEP ONE. Identification of T&E Information Required by Decision Makers from T&E. For Phase I~~the DEM/VAL phase~~, the test and evaluation requirements would have been identified, updated, and carried forward from the CE~~&D~~ phase. The TEMP is updated and prepared for approval at MS II. If required, an EOA is prepared. The RCM and the SMM are updated. Exit criteria for this phase are also defined.

4.1.1 As a minimum, T&E addresses the (generic) questions as depicted in Figure 11 and, more specifically, as listed below as they might relate to each EW EP:

Phase I - Program Definition and Risk Reduction

For each engineering prototype (EP),

(1) Existing data analysis - will the EP(s) work? What is the confidence level in this assessment?

(2) Can the requirements, as stated, be evaluated?

(3) Does the existing T&E infrastructure/technology base permit evaluation? Approximately what is the cost and time frame? If not, approximately what is the cost and time frame to create the infrastructure/technology base?

(4) What are the capabilities/limitations of each EP versus threats?

(5) How can T&E favorably impact risk management or risk reduction?

(6) What alternatives exist to testing/test assets? What are the risks?

(7) Has TEMP been approved? The TEMP must contain the performance parameters reflected in the ORD, analysis of alternatives, and APB. They must be consistent.

(8) Is each proposed EP feasible? Is one preferred?

(9) What are the recommended Phase II T&E "exit criteria"?

(10) What are the recommended criteria for certification of readiness for final OT&E?

(11) Does the EOA address the early projection of potential operational effectiveness and suitability criteria?

Figure 11. Phase I T&E Questions

(1) Existing data analysis - will the EP(s) work? What is the confidence level in this assessment? To what extent, for example, can the situational awareness be enhanced by an RWR EP, i.e., does it give the operator full four quadrant coverage?

(2) Can the requirements, as stated, be evaluated?

(3) Does the existing T&E infrastructure and technology base permit evaluation? Approximately what is the cost and time frame? If not, approximately what is the cost and time frame to create the appropriate infrastructure and technology base? If this is a software-controlled EW EP, are there software modifications to be addressed?

(4) What are the capabilities/ limitations of each EW EP versus threats? Is the receiver sensitivity sufficient to detect low-probability-of-intercept emitters? Is the circuitry sufficiently hardened against high power microwaves? Should it be? Is the threat library current?

(5) How can T&E favorably impact risk management or risk reduction? Is there a moderate-to-high risk technology issue that can be resolved early in this phase?

(6) What alternatives exist to testing/test assets? What are the risks?

(7) Has TEMP been approved? The TEMP must contain the performance parameters reflected in the ORD, analysis of alternatives ~~COEA~~, and APB. They must be consistent.

(8) Is each proposed EP feasible? Is one preferred, and if so, why?

(9) What are the recommended Phase II T&E "exit criteria"?

(10) What are the recommended criteria for certification of readiness for final OT&E?

(11) Does the EOA address the early projection of potential operational effectiveness and suitability criteria?

4.1.2 These questions are basically identical to the Phase 0 questions. However, because the program is more mature, more data at higher confidence levels will exist.

4.2 STEP TWO. Pre-test Analysis. Because Pre-test Analysis is more concerned with the "how to", or the methodology, of testing, the Pre-test analysis Step in ~~the DEM/VAL phase~~ Phase I seeks to build on the DT&E actions from Phase 0 by refining the test trials and test conditions to bring them closer to operational reality. The correlation between the model and the EP should be closer; and, both should be converging toward a match with the operational requirement. Development of expected outcomes is again emphasized. Future testing will again be able to take advantage of the data accumulated during this phase.

4.3 STEP THREE. Test Activity and Data Management. The objective of the T&E Process during Phase I ~~DEM/VAL~~ is to gather data to make trade-offs and to identify the preferred technical approach for satisfying an operational requirement. In the ~~DEM/VAL~~Phase I T&E, an EP should be tested to determine the expected performance of the proposed EW system. Test program planning should also identify any required upgrades to existing test resources or the need for new test resources in subsequent phases of the program which were not identified at MS I. Wherever practical, testing is to be planned and conducted to take full, cost effective advantage of existing investments in DoD ranges, facilities, and other resources, unless otherwise documented in the TEMP. In ~~DEM~~ Phase I the following are considered.

Historical Test Data. Building on the historical data search and evaluations performed during Phase 0, historical data in Phase I may be extremely valuable in developing confidence that the proposed development is possible and in reducing development risk by identifying successes and failures in earlier programs.

Measurement Tests. Prototype hardware may be subjected to the measurement of system parameters such as antenna gain patterns, receiver sensitivity, ERP, etc. This

type of data is needed as input to the analysis of system operation and to computer simulations. Representative measurements that are typically accomplished during Phase I include:

a. The directional accuracy of an antenna, its beamwidth, and gain pattern.

b. The radar cross section (RCS) of prototype lethal suppression missiles.

c. The IR signatures of prototype lethal suppression missile engines.

Integration Tests. It is likely that Phase I ~~DEM/VAL~~ testing will commence before components are tested and evaluated by the Government. This testing should focus on identifying EW system hardware and software problems, maturing system performance, and evaluating estimated reliability, availability, and maintainability (RAM) levels. The following are typical tests that can be conducted at this stage of the process: receiver stimulation, database characterization, display compatibility, and fault testing.

Hardware-in-the-Loop Tests. When system integration laboratory testing has been completed, engineering prototype components should be ready for HITL testing. Initial testing should be conducted against a rigorous test environment and mature the EW system in a non-adversarial manner. The main thrust of HITL testing is to evaluate the performance of actual hardware systems/subsystems~~and~~ in simulated environments.

Installed System Tests on final platforms will usually not occur in this ~~p~~Phase of system development. However, testing could be used for equipment mounted on test platforms where security and/or signal density requirements can best be accommodated.

Open-Air/Field Tests. The effects of some real-world environmental conditions can be investigated only under actual exposure to those conditions. Therefore, host platform testing may be required early in an EW system's development or modification cycle in order to evaluate its achieved performance. During ~~DEM~~Phase I, this can be accomplished by installing the EW system engineering prototype in a spread bench configuration, aboard a large-body testbed aircraft (or on a highly instrumented rocket sled, when precision position and velocity data are of interest), or on a mobile or fixed surface platform that would be indicative of the "real-world" environment.

Simulations/Stimulation Events. As in the CE~~&D~~ Phase, modeling and simulation should be used in lieu of actual testing where feasible to fill data voids. Hardware-in-the-loop facilities and open-air/field testing events provide a capability to test against man-in-the-loop threat simulations and surrogate weapon systems. The number of people involved and the complexity of the simulators can make this testing more expensive than in-plant system integration laboratory testing. Extensive pre-test analysis using computer simulations should be conducted to obtain the maximum benefit from subsequent hardware-in-the-loop and open-air/field testing. The use of a model

like ALARM, or a similar model, to assess technical performance should be considered.

Data Management. Data from the test events and trials in ~~the DEM/~~ Phase I are processed, as in the CE~~&D~~ phase, to convert raw data to a form that is understandable and useable to decision makers.

4.4 STEP FOUR. Post-test Synthesis and Evaluation consists of reducing and correlating these measured data for technical performance parameters, measures of effectiveness (MOEs), and measures of performance (MOPs), on both a quick-look and a thorough basis. This iterative assessment process begins with measurement testing and continues through ~~the~~ open air testing ~~conducted during DEM/VAL~~. The expected outcomes from Step Two should be used in computer simulations to make early assessments of operational effectiveness and suitability of the EP. Data collected from both the EW SUT and threat systems are correlated with aircraft flight paths as a function of time. Instrumentation that monitors the electromagnetic environment collects jammer and radar signal parameters and measures power levels. These data are compared with computer simulation or engineering estimations. All data are analyzed to determine test results.

4.4.1 Results from this p~~P~~hase must be reported through appropriate channels to the MDA. The results of these tests and evaluations will have a major impact on future program decisions. Where required, OT&E assessments are to be reported at the end of each phase of T&E. The reports from OAs and EOAs are to be submitted to the MDA or PDA as required. These reports should identify test limitations and their effects on the ability to demonstrate whether or not critical systems design issues and risk have been resolved. Results may lead to changes in specifications or may result in a redesign of the system.

4.5 STEP FIVE. Decision Maker Weighs T&E Information Against Other Program Information. The output of this step is an informed decision on the proper course of action to be taken at this point predicated upon the information received by the decision maker from the application of the Process to date.

4.5.1 Milestone II Decision Point. During the Milestone II review, the MDA/PDA reviews the results to confirm that they provide reasonable assurance that the technologies and processes critical to successful development of the EW system are attainable and that the threat assessment and mission need are still current and valid. The MDA approves the the acquisition strategy, the Cost as an Independent Variable (CAIV) objectives, t~~T~~he LRIP strategy and quantities, the exit criteria for Phase II, ~~and~~ the Developmental Acquisition Program B~~b~~aseline (APB), and entry ~~are all approved, and approval is granted to enter~~ into Phase II.

4.5.2 Developmental Baseline. Compared to the Concept Baseline, the Developmental Baseline contains more detailed and refined cost, schedule, and performance objectives and thresholds. The APB shall contain only the most important cost, schedule, and performance parameters. ~~The list of system and technical performance parameters should be expanded from the key parameters of the Concept Baseline that were derived from testing the engineering prototype.~~ Performance objectives set for Phase II should represent a realistic, meaningful, measurable, cost-effective, and affordable increment in operational capability beyond the minimum acceptable requirements.

4.5.3 Documentation. The MDA may require any or all of the following documents be updated at Milestone II ~~following is the program documentation required by DoDI 5000.2~~: 1) The STA~~R is updated at MS II and at other points in the program determined by the MDA. It~~ reflects new, validated threat assessments, as well as addresses any unresolved threat concerns and critical intelligence parameters that have surfaced during Phase I ~~DEM/VAL~~ T&E; 2) The ORD ~~is~~ may be updated and expanded for MS II to include thresholds and objectives for more detailed and refined performance capabilities and characteristics based on the results of trade-off studies and testing done during Phase I~~I~~ ~~,~~ Key parameters from the ORD are included in the Development Baseline at MS II; 3~~) The IPS at MS II summarizes the results of Phase I and how the exit criteria in the MS I ADM were satisfied. It also identifies further risk reduction efforts, trade-off decisions, a summary of cost estimates and assessments, and the proposed acquisition strategy, proposed waivers, any LRIP quantities and the T&E events to be accomplished prior to LRIP contract award; 4) The TEMP is finalized and contains data necessary to conduct DT&E and OT&E. DT&E events follow the conduct of test events and are labeled as DTI, DTIA, DTIB, etc. OT&E events are labeled in a similar manner. The update should describe testing performed to date and the attainment of thresholds and objectives of performance parameters~~. The SMM and the RCM should be ~~are~~ updated; and 4~~5~~) the analysis of alternatives ~~COEA~~ at MS II addresses the most promising system concept ~~demonstrated and validated in Phase II~~. Performance and cost intervals should be narrowed to point estimates. A sensitivity analysis should be ~~is~~ performed to identify any critical sensitivities of the EW system's effectiveness to test restrictions, such as safety constraints or test resource limitations. The TEMP must be finalized prior to Milestone II. The update describes DT&E and OT&E testing performed to date, the attainment of thresholds and objectives of performance parameters, and remaining DT&E and OT&E necessary to meet Milestone III exit criteria.

5. EW SYSTEMS T&E DURING PHASE II - ENGINEERING AND MANUFACTURING DEVELOPMENT (EMD)

5.0.1 Milestone II ~~Developmental~~ Approval to Enter Engineering and Manufacturing Development. The MS II decision determines if the progress of the selected EP(s) warrant ~~for~~ continued development ~~as production prototypes (PPs)~~. The T&E outcome is the assessment of each selected prototype.

5.0.2 EW Systems in Phase II - EMD.

5.0.2.1 Phase Description. The primary objectives of this phase are to: translate the most promising design approach into a stable, interoperable, producible, supportable, and cost-effective design; validate the manufacturing or production process; and, assess system capabilities through test and evalaution. Low Rate Initial Production (LRIP) occurs while the EMD phase is still continuing as test results and design fixes or upgrades are incorporated. ~~The main objective of this phase is to design, fabricate, test and evaluate an EW PP; to validate the manufacturing or production process confirming that design risks have been mitigated; and to demonstrate through testing that the system capabilities meet specificationrequirements and satisfy mission needs~~

5.0.2.2 T&E in EMD. The main objectives of T&E in EMD are to ensure that engineering is complete, to validate system performance of the production design in a realistic environment, and to ensure that specifications are met through preproduction and production qualification testing. Further, a test plan is developed to: ensure design problems are solved; provide the guidelines for software testing; validate configuration changes; validate system compatibility and interoperability with other EW systems and/or other platform electronic systems; and continue the reliability, availability, and maintainability program.

5.0.2.2.1 Developmental Test and Evaluation. DT&E conducted during this phase provides the final technical data to determine the EW system's readiness to transition into either LRIP or full-rate production. DT&E in EMD is conducted with prototype hardware and is characterized by the use of engineering and scientific approaches under controlled conditions to provide quantitative and qualitative data for use in the system's evaluation. Technical performance is measured with respect to both operational effectiveness and suitability factors that include reliability, availability, maintainability, compatibility, interoperability, safety, and supportability. The developing agency ~~implementing command~~ must certify that the EW system is ready for IOT&E.

5.0.2.2.2 Operational Test and Evaluation. The primary purpose of EMD OT&E is to support a full-rate production decision at Milestone III. An OA may be required to support LRIP of the system. After the developing agency ~~implementing command~~ certifies that the system is ready for IOT&E, the OTA conducts IOT&E on a representative production system to evaluate operational effectiveness and suitability

tests and to ensure that the system meets its minimum operational thresholds. IOT&E also addresses logistics and software support requirements, identifies deficiencies or the need for modifications, and provides information to refine training, tactics, countermeasure techniques, and doctrine.

5.1 STEP ONE. Identification of T&E Information Required By Decision Makers from T&E. The main objective of the Process in EMD is to ensure that the defined and selected operational effectiveness and suitability performance parameters, along with design, specification, and production characteristics, are still valid for the EW SUT.

5.1.1 As a minimum, T&E addresses the (generic) questions as depicted in Figure 12 and, more specifically as listed below as they might relate to each EW PP:

Phase II - Engineering & Manufacturing Development

For each production prototype (PP),

(1) For DT&E, what are the capabilities and limitations of each PP being developed? What is the confidence level in this data/assessment?

(2) For OT&E, are the PPs suitable and effective in satisfying the mission need? What is the confidence level of this assessment?

(3) Have key performance objectives/thresholds been validated versus advanced threats?

(4) Are the PPs feasible? Do they satisfy the need? Is one preferred?

(5) Have requirements changes been incorporated into the APB, ORD and contract specifications?

(6) Have specification changes been reflected back to requirements and incorporated into the APB and ORD?

(7) Does the TEMP reflect the changes in (5) and (6)? Has it been approved?

Figure 12. Phase II T&E Questions

(1) For DT&E, what are the capabilities and limitations of each PP being developed? What is the confidence level in these data and/or this assessment?

(2) For OT&E, are the PPs suitable and effective in satisfying the mission need? What is the confidence level of this assessment? Are the PPs "user friendly", i.e., are typical users exposed to the SUT and their reactions to system operations considered?

(3) Have key performance objectives/thresholds been validated versus advanced threats? Are the simulated threats sufficiently representative both in numbers and capability?

(4) Are the PPs feasible? Do they satisfy the need? Is one preferred? Is the design stable and producible?

(5) Have requirements changes been incorporated into the APB, ORD, and contract specifications?

(6) Have specification changes been reflected back into the requirements and incorporated into the APB and ORD?

(7) Does the TEMP reflect the changes in (5) and (6)? Has it been approved?

5.2 STEP TWO. Pre-test Analysis is conducted, as required, to analyze test trial conditions or establish expected outcomes before progressing through an orderly test process beginning with system integration laboratory (SIL) T&E and ending with field/open-air range testing. Evaluation actions in this Phase are continuous and begin with the Pre-test analysis. Computer aided simulation analysis may be used to assess the expected performance of the EW system under various test conditions and to complete any remaining pretest planning factors. In addition, the DSM, if used, is updated to support future evaluation of engineering change proposals (ECPs) and modifications.

5.3 STEP THREE. Test Activity and Data Management. EMD T&E is conducted to determine whether the EW system meets all critical operational requirements when it is produced in a cost effective manner. It is significant that the manufacturing and production process is validated at this point, and it represents a final opportunity for modifications to be made to the system design before the EW system enters final production. T&E conducted is commensurate with the capabilities required for that event. In the EMD Phase the following are considered.

Historical Test Data. During EMD, historical data searches can fulfill several functions: 1) Historical data may obviate the need for certain tests, 2) It may identify previously unsuccessful designs and either suggest improvements or steer the program clear of pitfalls, and 3) It may suggest or provide answers to questions raised when actual performance of the current SUT does not meet expectations.

Component Measurement Test events at this stage are much more likely and useful. With the EW system installed on projected host platforms, valid measurements can be made which confirm design capabilities, identify design deficiencies, and determine employment options. Measurement testing should establish values for technical performance parameters for installed antenna patterns, platform signatures, direction finding, component reliability under various field tests, and decoy trajectories.

Integration Tests. Similar to Phase I ~~DEM/VAL~~ testing, the EMD testing may begin in a test-fix-test sequence. An electromagnetic environment generator can be used to support this testing by stimulating components of the engineering prototype to evaluate performance and compliance with technical requirements. This testing should confirm that performance thresholds capable of being tested in the integration laboratory have been achieved and correct any identified hardware and software problems. Once the components of the SUT have been tested and evaluated they can be prepared for more rigorous evaluation.

Hardware-In-The-Loop (HITL) Tests. The production prototype components are usually tested in Government HITL test facilities before the system is installed in a

testbed for field/open-air testing. This ground testing should focus on confirming that identified problems have been fixed, that performance thresholds can be achieved, and on optimizing countermeasure techniques versus HITL threat simulators. Because a complete EW system is available for this testing (instead of just critical components as in Phase I ~~DEM/VAL~~ testing), this is the first opportunity to conduct integrated system effectiveness tests. Specific tests to be conducted depend on the functions included in the system. Some examples are:

a. Testing the capability of radio frequency (RF) warning receivers to process a high-density signal environment.

b. Optimizing RF countermeasures versus manned hybrid threat simulators and demonstrating achieved effectiveness in terms of tracking errors and missile miss distances.

c. Determining the effectiveness of RF countermeasures versus early warning/GCI radars and communication links.

Installed System Tests are normally the first opportunity to evaluate system operation on a weapon system platform. They are conducted to evaluate the integrated performance of EW subsystems as part of a weapon system platform. A prime purpose is to test the electromagnetic compatibility (EMC) of the EW SUT with other systems on the host platform. Some examples are:

a. Stimulate the EW system with mission representative threat signal environment and verify correct display when communication, navigation, and identification avionics systems are transmitting.

b. Confirm that RF receivers can detect and identify threats in specified times while blanked for jammer transmissions.

c. Measure jammer duty cycle to ensure it meets specifications.

d. Confirm jamming waveform and power level integrity is maintained throughout the system.

Field/Open-Air Tests present the first opportunity to measure selected performance parameters of the EW system in the actual operating environment of its host weapon system platform. They provide the means to calibrate the other classes of events (i.e., digital simulations, system integration, HITL, installed system tests) and to validate the expected outcomes and the measured outcomes thereby establishing an acceptable confidence factor. Flight testing normally begins with one-on-one scenarios and progresses to multiple threat system scenarios constructed to be as operationally realistic as possible, using available threat simulator resources, ranges, and range instrumentation. Some examples of EMD open-air range testing are:

a. Conduct pod stores release certification tests for pod-mounted systems.

b. Confirm that threat signals are detected at specified ranges and correctly identified.

c. Determine if countermeasures degradation of threat performance parameters meets required thresholds.

For IOT&E, field/open-air testing is indispensable for evaluating operational effectiveness and suitability because it provides the final basis for comparison of previously collected data and a point of departure for additional simulation, analysis, and evaluation.

Simulations/Stimulation Events. As in Phase I~~the DEM/VAL Phase~~, modeling and simulation should be used in EMD in lieu of actual testing where feasible to fill data voids. Computer simulations should be run to support pre-test analysis in order to structure new test trials and update the values expected for system performance and technical performance parameters. The use of models like AASPEM and SUPPRESSOR, or similar models, during this phase should be considered. Both AASPEM and SUPPRESSOR are appropriate for assessing operational performance.

Data Management. Data (e.g., antenna patterns, time responses, tracking, telemetry, firing events, operator logs) measured in various test facilities must be processed into a form suitable for analysis. The actual data may be understandable only to the analyst. This is particularly true during the early forms of testing when DSMs may be used more than the actual hardware. In this step, the data are turned into meaningful information which can be understood by the average person who has some familiarity with the system and the test requirements. Test managers must work closely with the test force and test range/facility personnel to determine what data are collected and the required reporting formats for the data. Once processed, time correlated measurement values can be used to conduct a post-test assessment of the results.

5.4 STEP FOUR. Post-test Synthesis and Evaluation. As higher-confidence test data from the EW PP become available, post-test synthesis and evaluation focuses on establishing demonstrated values for key system performance parameters and critical technical performance parameters. At this point, test data permits a more precise statistical assessment of actual system performance. Test data from IOT&E related activities are analyzed to determine system operational effectiveness and suitability. This aids in establishing confidence levels for the values and in the development of algorithms for future applications. Any developed simulation or model must, with the use of this analysis, be updated. Coupling the measured outcomes of testing with those expected from simulations and models provides an opportunity to revalidate the simulations and models and update their parameters to improve the model's accuracy.

Models can be used to evaluate the test data in terms of military needs and operational requirements. Feedback to the decision makers with information needed to assess the system's military worth and program viability is key to the process. The results of T&E in terms of assessments must be provided to the PM, PEO, MDAs, and other offices as required. This is accomplished through DT and OT final reports and briefings. This reporting enables the DoD EW T&E Process to provide analyzed and correlated data in understandable terms for a valid program assessment. In addition to the final reports, the feedback loop also includes archiving other relevant measured data and outcomes along with the test reports to facilitate the maintenance of a thorough history (audit trail) of the program. This archiving process also includes updating the SMM by indicating the measured outcomes resulting from testing the EW production prototype.

5.5 STEP FIVE. Decision Maker Weighs T&E Information Against Other Program Information to decide a proper course of action. When associated with an acquisition milestone, this decision is announced in an ADM which outlines the future course of action for the program and the SUT. Additionally, each milestone decision contains the "exit criteria" for the next Phase/Milestone.

5.5.1 Milestone III Decision Points. T&E results will be reported by the responsible test organization. The DT&E report compares assessed values of critical system performance parameters with threshold levels specified in the Phase II ~~Acquisition Program Baseline~~ APB (i.e., RCM and SMM). It also assesses the readiness of the system for IOT&E and production. The OTA prepares final IOT&E reports that are timely, factual, concise, complete, accurate, and objective. The final report assesses the adequacy of conducted OT&E, and whether the test and evaluation results confirm that items or components tested are operationally effective and suitable for use in combat by typical military users.

5.5.2 The Production Baseline documents the final performance thresholds and objectives, as well as costs and schedules, for ~~the Production and Deployment~~ Phase III of the program. At Milestone III, performance thresholds in the system development product specification should be traceable to the performance thresholds and objectives documented in the Production Baseline. These values are approved by the MDA at Milestone III.

5.5.3 Documentation. Listed below is the program documentation normally required by the MDA to be updated for Milestone III~~DoD Instruction 5000.2 that should be reviewed prior to this Phase and should contain the latest updates~~: 1) The STA~~R is~~ should be updated with emphasis on changed and/or updated critical intelligence parameters that may be generated as new requirements, 2) The ORD, after MS II, should be modified only as a result of changes in the MNS or cost-schedule-performance trade-offs during Phase II. Key parameters from the ORD are included in the Production Baseline at MS III. The T&E managers are immediately notified of any changes to ensure that system T&E can be executed ~~administered~~ without delay and that the required T&E strategy still enables the SUT to render the acceptable degree of

performance assessment ~~validity~~, 3) ~~The IPS is updated to describe program changes since MS II and how the exit criteria in the MS II ADM were satisfied. It will also address risk reduction efforts, any proposed preplanned product improvement (P3I) recommendations, program cost estimates and assessments, and the proposed acquisition strategy for the remainder of the program, 4)~~ The TEMP is updated, as required, and updates reflect testing completed and demonstrated values attained to date. The SMM and RCM should be ~~are~~updated and emphasis ~~is~~ placed on completion of DT&E, its certification, and progress towards IOT&E/FOT&E, 4~~5~~) At MS III, an analysis of alternatives ~~COEA~~ is not required unless conditions have changed sufficiently so that previous analysis of alternatives ~~cost effectiveness~~ determinations are no longer valid. _MS III analyses of alternatives often only provide updated estimates of life cycle costs. If a change is of sufficient magnitude to cause the DAB to revisit its MS II decision, the full MS II analysis of alternatives ~~COEA~~ is updated. The T&E concern here is changes to requirements which affect T&E events and actions, 5~~6~~) IOT&E Report. This additional document is required by law to be submitted to the Secretary of Defense and Congress for major acquisition programs. This is a DOT&E action.

6. SYSTEMS T&E DURING PHASE III - PRODUCTION, ~~AND~~ FIELDING/DEPLOYMENT, AND OPERATIONAL SUPPORT ~~(P&D)~~

6.0.1 Milestone III-Production Approval. The MS III decision determines whether to enter production and deploy the EW system(s) under development.

6.0.2 EW System T&E in Phase III ~~— P&D~~.

6.0.2.1 Phase Description. The main objective of Phase III~~the P&D phase~~ is to achieve an operational capability that satisfies mission needs, and ensure that an efficient and stable production process is established with an adequate technical support base~~, and to ensure that the~~. Other objectives are to conduct follow-on operational and production verification testing to confirm and monitor performance and quality and to verify the correction of deficiencies. Deficiencies encountered in Developmental Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) shall be resolved and fixes verified. During fielding/deployment and throughout operational support, the potential for modifications to the fielded/deployed system continues. If~~, during production,~~ a requirement for a major modification is identified~~,~~ that is of sufficient cost and complexity that it could itself qualify as an ACAT I program, it shall be considered for management purposes as a separate acquisition effort. Modifications that do not cross the ACAT I threshold shall be considered part of the program being modified~~an additional milestone, Milestone IV, may be required. It will be scheduled to review and approve any proposed modifications to the acquisition strategy, the program plan, and APB (concept, development or production) and establish the exit criteria that must be met. If the system is no longer in production, the need for an upgrade must be established through a new MNS.~~.

6.0.2.2 T&E in Phase III ~~P&D~~. The objectives of T&E in Phase III~~P&D~~ are to assess the ~~demonstrate an~~ operational capability of the production EW system relative to ~~that satisfies~~ the mission need, ~~and~~to identify additional follow-on operational test and evaluation (FOT&E) that may include follow-on operational and production verification testing in accordance with the TEMP, and to conduct developmetnal and operational test and evaluation on non-ACAT 1 level modifications.

6.0.2.2.1 Developmental T&E is conducted to confirm that specifications are being met on the production version of the system and to evaluate any product improvement changes, such as those resulting from ECPs, changes in the threat, efforts to reduce system life cycle costs, or efforts to improve system reliability, maintainability, and availability that are not part of an ACAT I modifiaction program. This is normally accomplished through a limited number of ground and flight tests. If no changes are made on the initial production systems, there should ~~not~~ be few ~~many~~additional DT&E requirements.

6.0.2.2.2 Operational T&E conducted on the production version of the system is usually termed FOT&E. FOT&E evaluates operational effectiveness and

suitability, examines non-ACAT I modifications or changes, and assesses ~~determines~~ whether the EW system meets operational and logistic support needs in changing operational environments. It is also used 1) to refine estimates of operational effectiveness and suitability made during IOT&E, 2) to evaluate changes made to correct deficiencies found in prior T&E, and 3) to identify potential additional deficiencies. FOT&E is conducted throughout the remainder of the system's life and further evaluates the system's operational effectiveness and suitability to update training, tactics, techniques, and doctrine and to identify potential deficiencies or the need for modifications.

6.1 STEP ONE. Identification of T&E Information Required By Decision Makers from T&E. The main objective in this phase is to refine those EW system concept(s), operational effectiveness and suitability performance parameters, along with design, specification, and production parameters that must be tested and evaluated to ensure that potential deficiencies and recognized modifications can be corrected or applied to the system. The SMM and RCM should be ~~are~~ updated with any applicable changes to thresholds and objectives of critical performance parameters that must be accomplished during Phase III.

6.1.1 As a minimum, T&E addresses the (generic) questions as depicted in Figure 13 and, more specifically, as listed below as they might relate to each EW system:

(1) For DT&E, what are the deployed system's capabilities and limitations? What are the capabilities and limitations of modifications and upgrades?

(2) For OT&E, does the EW system continue to be operationally suitable and effective in operational use? Do proposed modifications and upgrades increase the suitability and effectiveness of the system?

Phase III-Production, Fielding/Deployment, & Operational Support

For the selected system,

(1) For DT&E, what are the deployed system's demonstrated capabilities and limitations? What are the capabilities and limitations of modifications and upgrades?

(2) For OT&E, does the system continue to be operationally suitable and effective in operational use? Do proposed modifications and upgrades increase the suitability and effectiveness of the system?

(3) Have performance objectives/thresholds versus advanced threats been validated? Does the system meet these performance objectives/thresholds?

(4) Is the TEMP current?

Figure 13. Phase III T&E Questions

(3) Have performance objectives and thresholds against advanced threats been validated? Does the system meet these performance objectives and thresholds?

(4) Is the TEMP current?

~~(5) Should a MS IV be directed after MS III and, if so, what are the Phase IV T&E "exit criteria"?~~

6.2 STEP TWO. Pre-test Analysis. ~~Any~~ ~~c~~Changes in the hardware and software at this point in a program usually ~~often~~ require additional testing to verify and validate. As before, the process begins with pre-test analysis to evaluate changes to the baseline necessary either to correct noted deficiencies or to modify the system in response to threat changes. The data produced by this analysis are used to establish higher confidence expected values. The results continue to be used to support program decisions, and the DSM is updated to reflect any changes in demonstrated performance.

6.3 STEP THREE. Test Activity and Data Management. Testing develops the data to assess an operational capability for the production system that satisfies the mission need and identifies any additional required FOT&E. In~~the P&D Phase,~~ Phase III the following are considered:

Historical Test Data. During Phase III ~~P&D~~, the use of historical data is critical. Archiving system data in historical files allows evaluation of the nature of an observed deficiency. If it is observed only at a single location, the problem is probably not systemic and the search for solutions should first explore possible causes at that location. If the problem is widespread, a thorough review of the nuances of the deficiency may point more clearly to the source of the problem and may suggest or even dictate the solution or may prevent returning to a previous design that was earlier proven unacceptable.

Component Measurement Tests. Changes in the system's antennas, in antenna locations on platform(s), or in the host platform signature, require additional static measurements. Measurements are also conducted during field tests to obtain dynamic signature and antenna pattern parameters.

Integration Tests. The amount of SIL testing necessary in this phase depends on the number, extent, and complexity of changes to the system.

Hardware-In-The-Loop (HITL) Tests. If modifications are made to the system prior to or during production, additional HITL testing may be required. Changes to countermeasure-response functions, in particular, usually require additional HITL testing to verify that the proposed responses are effective.

Installed System Tests. Installed system testing continues during Phase III ~~the P&D Phase~~ to evaluate the installed system's interfaces and interoperability with other platform systems. The actual configuration of the system to be deployed is tested in installed system tests before testing on open-air ranges. This procedure helps in identifying problems, saves test hours, and produces more usable test runs.

Field/Open Air Tests. Open air range testing is often necessary to determine if the production configurations of the system satisfy user requirements. This testing may include new threat simulators that are more representative of the actual threat and may employ expanded test scenarios as more test assets become available. These tests should confirm whether system performance requirements established in previous phases have been achieved.

Simulations/Stimulation Events. As in the EMD Phase, modeling and simulation should be used in Phase III ~~P&D~~ in lieu of actual testing where feasible to fill data voids. When new test scenarios are developed to respond to changes in requirements, computer simulations should be used to design new test trials and estimate test results.

Data Management. Data are processed into meaningful information that can be understood by a person who has some familiarity with the system and the test requirements. Once processed, time correlated measurement values can be used to conduct a post-test assessment of the results.

6.4 STEP FOUR. Post-test Synthesis and Evaluation. As higher quality test data from production systems become available, post-test synthesis and evaluation focuses on establishing demonstrated values for key system performance parameters and critical technical performance parameters. At this point, test data permit a more precise statistical analysis of achieved system performance and effectiveness and establishes confidence levels for performance parameter values.

The data provided as feedback are presented in the form of assessments that aid the decision makers in reaching their decisions on the progress of the SUT. Full rate production of the system is achieved during Phase III~~the P&D Phase~~. Before full-rate production is initiated, however, open ECPs should be evaluated and resolved. ECPs may also be generated due to changes in threat and cost projections, or to achieve reliability and maintainability growth goals. Full-Rate Production incorporates the changes generated by approved ECPs during the EMD Phase. These changes are installed on new host platforms to establish the initial deployment of the EW system. Frequently, a number of the full-rate production systems are used as test items for DT&E and FOT&E.

6.5 STEP FIVE. Decision Maker Weighs T&E Information Against Other Program Information. The output of this step is an informed decision on the proper course of action to be taken at this point predicated upon the information received by the decision maker from the application of the Process to date.

~~7. EW SYSTEMS T&E DURING PHASE IV - OPERATIONS AND SUPPORT (O&S)~~

78. SUMMARY

The DoD T&E Process for Electronic Warfare Systems is a disciplined and consistent process designed to provide T&E information to the decision makers. This information, when applied with other program information, enables the appropriate decision making elements to arrive at concrete decisions regarding system maturation.

This Process, comprised of five steps, is iterative and assesses military worth in terms of the system contribution in meeting military needs. The T&E methodology provides for consistent testing of EW systems, provides for comprehensive T&E of performance objectives and thresholds using sophisticated testing resources, results in an accurate documentation of test result data, and calls for timely analysis to be forwarded to decision makers in the form of DT&E and OT&E assessments. Consistent and accurate information provided to decision makers is necessary to achieve timely system development which satisfies user needs.

This T&E Process may be applied to the acquisition of an EW system in all DoD Components. It is consistent with the DoD Acquisition Process and appropriately defined within DoD 5000 series documentation. It is expressly intended to assist acquisition executives, program managers, program test coordinators, test organization personnel, and others involved in the management of T&E of new, or highly modified, EW systems.

APPENDIX A

ABBREVIATIONS AND ACRONYMS

AARM	Anti-Air Anti-radiation Missile
AASPEM	Advanced Air-to-air System Performance Model
ACAT	Acquisition Category
ADM	Acquisition Decision Memorandum
ALARM	Advanced Low Altitude Radar Model
APB	Acquisition Program Baseline
ATD	Advanced Technology Demonstration
CAIV	Cost as an Independent Variable
CE~~&D~~	Concept Exploration~~ & Definition~~
CJCS	Chairman of the Joint Chiefs of Staff
~~COEA~~	~~Cost and Operational Effectiveness Analys~~
COI	Critical Operational Issue
CTP	Critical Technical Parameter
C2W	Command & Control Warfare
DECM	Deceptive Electronic Countermeasures
~~DEM/VAL~~	~~Demonstration & Validation (Phase)~~
DIA	Defense Intelligence Agency
DoD	Department of Defense
DoDD	DoD Directive
DoDI	DoD Instruction
DSM	Digital System Model
DSMC	Defense Systems Management College

DT&E	Development Test and Evaluation
EA	Electronic Attack
ECCM	Electronic Counter Countermeasures
ECM	Electronic Countermeasures
ECP	Engineering Change Proposal
EMD	Engineering and Manufacturing Development
EOA	Early Operational Assessment
EP	Electronic Protection
ERP	Effective Radiated Power
ES	Electronic Support
EW	Electronic Warfare
FOT&E	Follow-on Operational T&E
HARM	High-speed Anti-Radiation Missile
HITL	Hardware-in-the-loop
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
~~IPS~~	~~Integrated Program Summary~~
IR	Infra-red
IRCM	Infra-red Countermeasures
JCS	Joint Chiefs of Staff
JC2WC	Joint Command and Control Warfare Center (formerly JEWC)
JEWC	Joint Electronic Warfare Center
J-MASS	Joint Modeling and Simulation System

MDA	Milestone Decision Authority
MNS	Mission Need Statement
MOE	Measurement of Effectiveness
MOP	Measure of Performance, Memorandum of Policy
MS	Milestone
MTI	Moving Target Indicator
OPSEC	Operational Security
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OTA	Operational Test Agency
OT&E	Operational T&E
PDA	Program Decision Authority
PEO	Program Executive Officer
PM	Program Manager
PP	Production Prototype
PSYOP	Psychological Operations
P3I	Preplanned Product Improvement
RAM	Reliability, Availability, and Maintainability
RCM	Requirements Correlation Matrix
RCS	Radar Cross Section
RDA	Research, Development, and Acquisition
SAM	Surface-to-Air Missile

SEAD	Suppression of Enemy Air Defenses
SIL	System Integration Laboratory
SMM	System Maturity Matrix
STA~~R~~	System Threat Assessment ~~Report~~
SUT	System Under Test
TEMP	T&E Master Plan
TST	Tactical SIGINT Technology
USD(A&T)	Under Secretary of Defense for Acquisition and Technology
WARM	Wartime Reserve Modes

APPENDIX B

DEFINITIONS

ACQUISITION CATEGORY (ACAT) Categories established for acquisition programs to facilitate decentralized decision making and execution and compliance with statutorily imposed requirements. The categories determine the level of review, decision authority, and applicable procedures. (DoD 5000.2-R~~DoDI 5000.2~~)

a. ACAT I. Has been designated by the Under Secretary of Defense (Acquisition and Technology) as an ACAT I program or has an eventual RDT&E expenditure of more than $200 million and a procurement expenditure of more than $1 billion in 1980 constant dollars.

b. ACAT II. Has been designated by the DoD head component as an ACAT II program. Has an eventual RDT&E~~RD&E~~ expenditure of more than $75 million and a procurement expenditure of $300 Million in 1980 constant dollars.

c. ACAT III. Programs not meeting the criteria for ACAT I or II that have been designated Category II by the DoD Component Acquisition Executive.

d. ACAT IV. Other acquisition programs for which the milestone decision authority should be delegated to a level below that required for ACAT III.

ACQUISITION PROCESS The basis for comprehensive management and the progressive decision making associated with program maturation. The acquisition process consists of five major milestone decision points and five phases (Concept Exploration~~and Definition~~, Demonstration and Validation, Engineering and Manufacturing Development, Production and Deployment, and Operations and Support). (DoD 5000.2-R~~DoDI 5000.2~~)

ACQUISITION DECISION MEMORANDUM (ADM) A memorandum signed by the milestone decision authority that documents decisions made and the exit criteria established as the result of a milestone decision review or in-process review. (DoD 5000.2-R~~DoDI 5000.2~~)

ACQUISITION PLAN A formal written document reflecting the specific actions necessary to execute the approach established in the approved acquisition strategy and guiding contractual implementation. (FAR Subpara. 7.1)

ACQUISITION PROGRAM A directed, funded effort that is designed to provide a new or improved materiel capability in response to a validated need. (DoDD 5000.1)

ACQUISITION PROGRAM BASELINE (APB) A document required for all acquisition categories that embodies the cost, schedule, and performance objectives for the program. (DoD 5000.2-R~~DoDI 5000.2~~)

ACQUISITION STRATEGY The master plan for program execution from program initiation through post-production support. It is to be developed in sufficient detail to establish the managerial approach that will be used to direct and control all elements of the acquisition to achieve program objectives. (DoD 5000.2-R~~DoDI 5000.2~~)

ANTI-RADIATION MISSILE A missile which homes passively on a radiation source. (CJCS MOP 6)

AVAILABILITY A measure of the degree to which an item is in the operable and committable state at the start of a mission when the mission is called for at an unknown (random) time. (DoD 5000.2-R~~DoDI 5000.2~~)

AVIONICS Electrical and electronic systems and devices used in aviation, missilery, and astronautics. (Commonly used military jargon that is a contraction of aviation electronics) (EW T&E Task Force)

BRASSBOARD CONFIGURATION An experimental device (or group of devices) used to determine feasibility and to develop technical and operational data. It normally is a model sufficiently hardened for use outside of laboratory environments to demonstrate the technical and operational principles of immediate interest. It may resemble the end item, but is not intended for use as the end item. (EW T&E Task Force)

BREADBOARD CONFIGURATION An experimental device (or group of devices) used to determine feasibility and to develop technical data. It normally is configured only for laboratory use to demonstrate the technical principles of immediate interest. It may not resemble the end item and is not intended for use as the projected end item. (EW T&E Task Force)

CLOSED LOOP A term used frequently in testing electronic systems to characterize a situation in which both the SUT and a stimulating system (usually a threat system) can mutually respond and interact, and the responses and/or behavior of both are measured or recorded. (EW T&E Task Force)

COMMAND AND CONTROL (C^2) The exercise of authority and direction by a properly designated commander over assigned or attached forces in the accomplishment of the mission. C^2 functions are performed through an arrangement of personnel,

equipment, communications, computers, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in accomplishment of the mission. (Joint Pub 1-02)

COMMONALITY A quality which applies to materiel or systems: a. possessing like and interchangeable characteristics enabling each to be utilized, or operated and maintained, by personnel trained on the others without additional specialized training; b. having interchangeable parts and/or components; or c. applying to consumable items interchangeably equivalent without adjustment. (Joint Pub 1-02)

COMPATIBILITY The capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference. (Joint Pub 1-02)

CONCEPT A notion or statement of an idea, expressing how something might be done or accomplished, that may lead to an accepted procedure. (Joint Pub 1-02)

CONCEPT BASELINE The baseline approved at Milestone I that contains broad objectives and thresholds for key cost, schedule, and performance parameters. It is submitted by the designated component official through the MDA as a stand-alone part of the MS I documentation. (DoD 5000.2-R~~DoDI 5000.2~~)

ANALYSIS OF ALTERNATIVES ~~COST AND OPERATIONAL EFFECTIVENESS ANALYSIS (COEA)~~ An analysis of the estimated costs and operational effectiveness of alternative materiel systems to meet a mission need and the associated program for acquiring each alternative. (DoD 5000.2-R~~DoDI 5000.2~~)

COST AS AN INDEPENDENT VARIABLE (CAIV) The acquisition strategy shall address methodologies to acquire and operate affordable DoD systems by setting aggressive, achievable cost objectives and managing achievement of these objectives. Cost objectives shall be set to balance mission needs with projected out-year resources, taking into account anticipated process improvements in both DoD and defense industries. (DoD 5000.2-R)

COST EFFECTIVENESS A measure of the operational capability added by a system as a function of its life-cycle cost. (D~~(~~oD 5000.2-R~~DoDI 5000.2~~)

CRITICAL DESIGN REVIEW (CDR) A review conducted to determine that the detailed design satisfies the performance and engineering requirements of the development specification; to establish the detailed design compatibility among the item and other items of equipment, facilities, computer programs, and personnel; to assess producibility and risk areas; and to review the preliminary product specifications. Conducted during Phase I, Phase I ~~DEM/VAL~~ (for prototypes) and Phase II, EMD. (DoD 5000.2-R~~DoDI 5000.2~~)

CRITICAL OPERATIONAL ISSUE (COI) A key operational effectiveness or operational suitability issue that must be examined in operational test and evaluation to determine the system's capability to perform its mission. A critical operational issue is normally phrased as a question to be answered in evaluating a system's operational effectiveness and/or operational suitability. (DoD 5000.2-R~~DoDI 5000.2~~)

CRITICAL SYSTEM CHARACTERISTICS Design features that determine how well the proposed concept or system will function in its intended operational environment. They include survivability; transportability; energy efficiency; and interoperability, standardization, and compatibility with other forces and systems including support infrastructure. (DoD 5000.2-R~~DoDI 5000.2~~)

CRITICAL TECHNICAL PARAMETERS Design-specific system performance and/or technical parameters characterizing system capabilities required to achieve key performance threshold values. (DoD 5000.2-R~~DoDI 5000.2~~)

DESIGN The process of converting specifications into a visual or mathematical representation of the system. (EW T&E Task Force)

DETECTION The perception of an object of possible military interest but unconfirmed by recognition. (Joint Pub 1-02)

DEVELOPMENT BASELINE Baseline containing more detailed and refined objectives and thresholds for key cost, schedules and performance parameters then the concept baseline. It is submitted as a stand-alone part of the Milestone II documentation. (DoD 5000.2-R~~DoDI 5000.2~~)

DEVELOPMENT TEST AND EVALUATION (DT&E) Activity that is conducted to demonstrate that the engineering design and development process is complete. It is used to reduce risk, validate and qualify system design and to ensure that the end-product is ready for operational test and evaluation. The DT&E is the responsibility of the materiel developer. (DSMC)

DIRECTED ENERGY An umbrella term covering technologies that relate to the production of a beam of concentrated electromagnetic energy or atomic or subatomic particles. Also called DE. (CJCS MOP 6)

DIRECTED-ENERGY WEAPON A system using directed-energy primarily as a direct means to damage or destroy enemy equipment, facilities, and personnel. (CJCS MOP 6)

DoD COMPONENT ACQUISITION EXECUTIVE A single official within a DoD Component who is responsible for all acquisition functions within that Component.

This includes Service Acquisition Executives for the Military Departments and Acquisition Executives in other DoD Components who have acquisition management responsibilities. (DoD 5000.2-R~~DoDI 5000.2~~)

EARLY OPERATIONAL ASSESSMENT An operational assessment conducted prior to, or in support of, Milestone II. (DoD 5000.2)

ELECTROMAGNETIC COMPATIBILITY (EMC) The ability of systems equipment, and devices that utilize the electromagnetic spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of electromagnetic radiation or response. It involves the application of sound electromagnetic spectrum management; system, equipment, and device design configuration that ensures interference-free operation; and clear concepts and doctrines that maximize operational effectiveness. (CJCS MOP 6)

ELECTROMAGNETIC DECEPTION The deliberate radiation, re-radiation, alteration, suppression, absorption, denial, enhancement, or reflection of electromagnetic energy in a manner intended to convey misleading information to an enemy or to enemy electromagnetic-dependent weapons thereby degrading or neutralizing the enemy's combat capability. (CJCS MOP 6)

ELECTROMAGNETIC ENVIRONMENT (EME) The resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted electromagnetic emission levels that may be encountered by a military force, system, or platform when performing its assigned mission in its intended operational environment. (Joint Pub 1-02)

ELECTROMAGNETIC HARDENING Action taken to protect personnel, facilities, and/or equipment by filtering, attenuating, grounding, bonding, and/or shielding against undesirable effects of electromagnetic energy. (CJCS MOP 6)

ELECTROMAGNETIC INTERFERENCE (EMI) Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like. (CJCS MOP 6)

ELECTROMAGNETIC JAMMING The deliberate radiation, re-radiation, or reflection of electromagnetic energy for the purpose of preventing or reducing an enemy's effective use of the electromagnetic spectrum, and with the intent of degrading or neutralizing the enemy's combat capability. (CJCS MOP 6)

ELECTRONIC COUNTER-COUNTERMEASURES (ECCM) The division of electronic warfare involving actions taken to ensure friendly effective use of the electromagnetic spectrum despite the enemy's use of electronic warfare. (Joint Pub 1-02)

ELECTRONIC COUNTERMEASURES (ECM) The division of electronic warfare involving action taken to prevent or reduce the enemy's effective use of the electromagnetic spectrum. It includes electronic jamming and electronic deception. (Joint Pub 1-02)

ELECTRONIC MASKING The controlled radiation of electromagnetic energy on friendly frequencies in a manner to protect the emissions of friendly communications and electronic systems against enemy ESM/SIGINT (electronic warfare support measures/signals intelligence), without significantly degrading the operation of friendly systems. (CJCS MOP 6)

ELECTRONIC WARFARE EXPENDABLES Nonrecoverable EW devices such as chaff, flares, unmanned vehicles, decoys, and unattended jammers. (CJCS MOP 6)

ELECTRONICS INTELLIGENCE (ELINT) Technical and intelligence information derived from foreign non-communications electromagnetic radiations emanating from other than nuclear detonations or radioactive sources. (CJCS MOP 6)

EMISSION CONTROL (EMCON) The selective and controlled use of electromagnetic, acoustic, or other emitters to optimize command and control capabilities while minimizing, for operations security (OPSEC), detection by enemy sensors; to minimize mutual interference among friendly systems; and/or to execute a military deception plan. (CJCS MOP 6)

ENGINEERING CHANGE PROPOSAL (ECP) A formal document used to make engineering changes in an existing contract. (DSMC)

ENGINEERING PROTOTYPE (EP) A development model of a unit that is close to production. The term may apply to circuitry, a device (black box) or a system, and may be in a breadboard (technical) configuration. (EW T&E Task Force)

EVALUATION The technical and/or operational study and investigations by a developing and/or operational agency to determine the technical and/or operational suitability and effectiveness of material, equipment, or a system for use in the military Services. (Joint Pub 1-02)

EVALUATION CRITERIA Standards by which accomplishments of required technical and operational effectiveness and/or suitability characteristics or resolution of operational issues may be assessed. (DoD 5000.2-R)

EXIT CRITERIA Program specific accomplishments that must be satisfactorily demonstrated before an effort or program can proceed further in the current acquisition phase or transition to the next acquisition phase. Exit criteria may include such factors as critical test issues, the attainment of projected growth curves and baseline parameters, and the decision to proceed further. Exit criteria are specific to each acquisition phase. DoD 5000.2-R)

FOLLOW ON OPERATIONAL TEST AND EVALUATION Test and evaluation that is necessary during and after the production period to refine the estimates made during operational test and evaluation, to evaluate changes, and to reevaluate the system to ensure it continues to meet operational needs and retains its effectiveness in a new environment or against a new threat. (DoD 5000.2-R)

FULL RATE PRODUCTION Production of economic quantities following stabilization of the system design and prove-out of the production process. (DoD 5000.2-R)

IDENTIFICATION The process of determining the friendly or hostile character of an unknown detected contact. (Joint Pub 1-02)

IMITATIVE ELECTROMAGNETIC DECEPTION The introduction of electromagnetic energy into enemy systems that imitates enemy emissions. (CJCS MOP 6)

INITIAL OPERATIONAL CAPABILITY The first attainment of the capability to employ effectively a weapon, item of equipment, or system of approved specific characteristics, and which is manned or operated by a trained, equipped, and supported military unit or force. (DoD 5000.2-R~~DoDI 5000.2~~)

INITIAL OPERATIONAL TEST AND EVALUATION (IOT&E) All operational test and evaluation conducted on production or production representative articles, to support the decision to proceed beyond low-rate initial production. It is conducted to provide a valid estimate of expected system operational effectiveness and operational suitability. (DoD 5000.2-R~~DoDI 5000.2~~)

INSTRUMENTATION The installation and use of electronic, gyroscopic, and other instruments for the purpose of detecting, measuring, recording, telemetering, processing, or analyzing different values or quantities as encountered in the flight of an aircraft, missile, or spacecraft. Instrumentation applies to flight-borne, sea-borne, and ground-based equipment. (AFM 11-1)

~~**INTEGRATED PROGRAM SUMMARY (IPS)** A DoD component document prepared and submitted to the milestone decision authority in support of Milestone I IV~~

~~reviews. It succinctly highlights the status of the program and its readiness to proceed into the next phase of the acquisition process. (DoDI 5000.2)~~

INTEROPERABILITY The ability of systems, units, or forces to provide services to or accept services from other systems, units, or forces and to use the services so exchanged to operate effectively together. (DoD 5000.2-R~~DoDI 5000.2~~)

JOINT REQUIREMENTS OVERSIGHT COUNCIL (JROC) The JROC is responsible to the Chairman of the Joint Chiefs of Staff for assessing military requirements in support of the defense acquisition process. The Vice Chairman of the Joint Chiefs of Staff chairs the Council and decides all matters before the Council. The permanent members include the Vice Chiefs of the Army and Air Force, the Vice Chief of Naval Operations, and the Assistant Commandant of the Marine Corps. The Council directly support the Defense Acquisition Board through the review, validation, and approval of military requirements at the start of the acquisition process, prior to each milestone review, or as requested by the Under Secretary of Defense for Acquisition and Technology. (DoD 5000.2-R~~DoDI 5000.2~~)

KEY PARAMETERS Those parameters that, if the thresholds are not met, the milestone decision authority would require a reevaluation of alternative concepts or design approaches. They are derived from the ORD and included as thresholds in baseline documentation. (DoD 5000.2-R~~DoDI 5000.2~~)

LIFE-CYCLE COST The total cost to the Government of acquisition and ownership of that system over its useful life. It includes the cost of development, acquisition, support and, where applicable, disposal. (DoD 5000.2-R~~DoDI 5000.2~~)

LIVE FIRE TEST AND EVALUATION REPORT A report to be submitted by the DOT&E and approved by the Secretary of Defense (or as delegated to ~~the Under Secretary of Defense for~~ the USD(A&T) for applicable (covered under the live fire test law) ACAT I and II programs ~~or the Director, Defense Research & Engineering, for applicable ACAT II programs~~) to the Committees on Armed Services and on Appropriations of the Senate and the House of Representatives prior to a decision to proceed beyond low-rate initial production (LRIP). It is also required for a covered product improvement program of any acquisition category which is likely to significantly affect the survivability of a covered major system or the lethality of a major munition or missile produced under an ACAT I or II program. (DoD 5000.2-R~~DoDI 5000.2~~)

LIVE SIMULATION A component of simulation that involves operations with real force or personnel and real equipment or test items in the air, on the ground, on or below the sea, or in a test facility. (Defense Science Board)

LOGISTICS SUPPORTABILITY The degree to which planned logistics support (including test, measurement, and diagnostic equipment; spares and repair parts; technical data; support facilities; transportation requirements; training; manpower; and software support) allow meeting system availability and wartime usage requirements. (DoD 5000.2-R~~DoDI 5000.2~~)

LOW RATE INITIAL PRODUCTION (LRIP) The production of a system in limited quantity to provide articles for OT&E, to establish an initial production base, and to permit an orderly increase in the production rate sufficient to lead to full-rate production upon successful completion of operational testing. (DoD 5000.2-R)

MAINTAINABILITY The ability of an item to be retained in or restored to a specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. (DoD 5000.2-R~~DoDI 5000.2~~)

MAJOR MODIFICATION A modification that in and of itself meets the criteria of acquisition category (ACAT) I or II or is designated as such by the milestone reviewing authority. A major modification is necessitated by: 1) a change in the threat or Defense Planning Guidance, 2) a deficiency identified during follow-on operational testing, or 3) operational training and support, or an opportunity to reduce the cost of system ownership. Within the context of this EW T&E process, the need for a major modification would dictate that the system reenter the acquisition process at Phase 0 and restart with the definition of requirements to begin a new conceptual design. (DoD 5000.2-R~~DoDI 5000.2~~)

MANIPULATIVE ELECTROMAGNETIC DECEPTION -Actions to eliminate revealing, or convey misleading, electromagnetic telltale indicators that may be used by hostile forces. (CJCS MOP 6)

MEASURES OF EFFECTIVENESS (MOEs) Tools that assist in discriminating among a number of alternatives, normally to answer a Critical Operational Issue (COI). They show how the alternatives compare in meeting functional objectives and mission needs. They are "predictions" of how a system will perform when fielded, and are usually expressed as a probability or likelihood, and usually inferred. (DoD 5000.2-M)

MEASURES OF PERFORMANCE (MOPs) MOPs are quantitative and qualitative measures of a system's performance or system characteristic. MOPs indicate the degree to which a system performs the task or meets a requirement under specified conditions. MOPs should address system capabilities and characteristics and should relate to the MOE(s) such that the effect of a change in the MOP can be related to a change in the MOE. (AR 73-1)

MEASUREMENT AND SIGNATURE INTELLIGENCE (MASINT) Scientific and technical intelligence information obtained by quantitative and qualitative analysis of data (metric, angle, spatial, wavelength, time dependence, modulation, plasma, and hydromagnetic) derived from specific technical sensors for the purpose of identifying any distinctive features associated with the source, emitter, or sender and to facilitate subsequent identification and/or measurement of the same. (CJCS MOP 6)

MILESTONE DECISION AUTHORITY The individual designated in accordance with criteria established by the Under Secretary of Defense for Acquisition and Technology to approve entry of an acquisition program into the next phase. (DoDD 5000.1)

MILESTONES Major decision points that separate the phases of an acquisition program. (DoDD 5000.1)

MILITARY DECEPTION Actions executed to mislead foreign decision makers, causing them to derive and accept desired appreciations of military capabilities, intentions, operations, or other activities that evoke foreign actions that contribute to the originator's objective. (CJCS MOP 30)

MINIMUM ACCEPTABLE OPERATIONAL REQUIREMENT The value for a performance or technical parameter that is required to provide a system capability that will satisfy the validated mission need. Also known as the performance threshold. (DoD 5000.2-R~~DoDI 5000.2~~)

MISSION NEEDS STATEMENT (MNS) A statement, expressed in broad operational terms, of operational capability required to perform an assigned mission or to correct a deficiency in existing capability to perform the mission. (DoD 5000.2-R~~DoDI 5000.2~~)

MISSION RELIABILITY The probability that the system will perform mission essential functions for a period of time under the conditions stated in the mission profile. (DoD 5000.2-R~~DoDI 5000.2~~)

MODEL A representation of an actual or conceptual system that involves mathematics, logical expressions, or computer simulations that can be used to predict how the system might perform or survive under various conditions or in a range of hostile environments. (DoD 5000.2-R~~DoDI 5000.2~~)

MODIFICATION A change to a system (whether for safety, to correct a deficiency, or to improve program performance) that is still being produced. (DoD 5000.2-R~~DoDI 5000.2~~)

NONDESTRUCTIVE ELECTRONIC WARFARE -Those EW actions, not including employment of WARM, that deny, disrupt, or deceive rather than damage or destroy. (CJCS MOP 6)

NON-DEVELOPMENTAL ITEM 1. Any item of supply that is available in the commercial marketplace; 2. Any previously developed item of supply that is in use by a department or agency of the United States, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement; 3. Any item of supply described in definition 1 or 2., above, that requires only minor modification in order to meet the requirements of the procuring agency; or 4. Any item of supply that is currently being produced that does not meet the requirements of definition 1., 2., or 3. above, solely because of the item is not yet in use or is not yet available in the commercial marketplace. (DoD 5000.2-R~~DoDI 5000.2~~)

OBJECTIVE Value beyond the threshold that could potentially have measurable, beneficial impact on capability or operations and support above that provided by the threshold value. (DoD 5000.2-R~~DoDI 5000.2~~)

OPEN-AIR TEST Testing performed in an outdoor operating environment, i.e., on an open-air test range or on an airborne platform. (EW T&E Task Force)

OPEN LOOP A test scenario in which only one system is allowed to interact to another's actions. For example, in the test of jammer against a SAM system, emissions from the SAM are received by the jammer, which begins jamming. The simulated SAM system, however, is not allowed to receive or react to this jamming. (EW T&E Task Force)

OPERATIONAL ASSESSMENT An evaluation of operational effectiveness and operational suitability made by an independent operational test activity, with user support as required, on other than production systems. The focus of an operational assessment is on significant trends noted in development efforts, programmatic voids, areas of risk, adequacy of requirements, and the ability of the program to support adequate operational testing. Operational assessments may be made at any time using technology demonstrators, prototypes, mockups, engineering development models, or simulations but will not substitute for the independent operational test and evaluation necessary to support full production decisions. (DoD 5000.2-R~~DoDI 5000.2~~)
~~**OPERATIONAL CONCEPT** The way in which forces and equipment are arranged and employed in battle. This includes both doctrine and tactics concerning how a system would be used to accomplish national objectives. (DoDD 5000.2-M)~~

OPERATIONAL EFFECTIVENESS The overall degree of mission accomplishment of a system when used by representative personnel in the environment planned or expected (e.g., natural, electronic, threat, etc.) for operational employment of the system considering organization, doctrine, tactics, survivability, vulnerability, and

threat (including countermeasures, initial nuclear weapons effects, nuclear, biological, and chemical contamination (NBCC) threats). (DoD 5000.2-R~~DoDI 5000.2~~)

OPERATIONAL REQUIREMENT An established need justifying the timely allocation of resources to achieve a capability to accomplish approved military objectives. (Joint Pub 1-02)

OPERATIONAL REQUIREMENTS DOCUMENT (ORD) A formatted statement containing performance (operational effectiveness and suitability) and related operational parameters for the proposed concept or system. It is used to develop requirements for contract specifications during each acquisition phase. The ORD is initially prepared by the user or user's representative during P~~p~~hase 0, Concept Exploration ~~and Definition~~, for the preferred concept(s) to be proposed at Milestone I. (DoD 5000.2-R~~DoD 5000.2-M~~)

OPERATIONAL SUITABILITY The degree to which a system can be placed satisfactorily in field use, considering availability, compatibility, transportability, interoperability, reliability, wartime usage rates, maintainability, safety, human factors, manpower supportability, logistics supportability, natural environmental effects and impacts, documentation, and training requirements. (D~~. (~~oD 5000.2-R~~DoDI 5000.2~~)

OPERATIONAL TEST AGENCY (OTA) The command or agency designated by the program management directive, or other appropriate directive, as responsible for managing and conducting the independent OT&E of a system. (DoD 5000.2-R~~DoDI 5000.2~~)

OPERATIONAL TEST AND EVALUATION (OT&E) Test and evaluation conducted in as realistic an operational environment as possible to determine the operational effectiveness and suitability of a system under realistic combat conditions and to determine if the minimum acceptable operational performance requirements as specified in the ORD have been satisfied. (DoD 5000.2-R~~DoDI 5000.2~~)

OPERATIONS SECURITY (OPSEC) A process of identifying critical information and subsequently analyzing friendly actions attendant to military operations and other activities to: a.) Identify those actions that can be observed by adversary intelligence, b.) Determine indicators adversary intelligence might obtain that could be interpreted or pieced together to derive critical information in time to be useful to adversaries, and c.) Select and execute measures that eliminate or reduce to an acceptable level the vulnerabilities of friendly actions to adversary exploitation. Also called OPSEC. (CJCS MOP 30)

PERFORMANCE Those operational and support characteristics of the system that allow it to effectively and efficiently perform its assigned mission over time. The support characteristics of the system include both supportability aspects of the design

and the support elements necessary for system operation. (DoD 5000.2-R~~DoDI 5000.2~~)

PERFORMANCE OBJECTIVE The performance parameter value beyond the minimum operational requirement that could have a beneficial impact on achieved operational capability. (DoD 5000.2-R~~DoDI 5000.2~~)

PERFORMANCE THRESHOLD The performance parameter value that meets the minimum level of system performance that will satisfy the validated mission need. Also known as the minimum acceptable operational requirement (DoD 5000.2-R~~DoDI 5000.2~~)

PRELIMINARY DESIGN REVIEW (PDR) A review conducted on each configuration item to evaluate the progress, technical adequacy, and risk resolution of the selected design approach; to determine its compatibility with performance and engineering requirements of the development specification; and to establish the existence and compatibility of the physical and functional interfaces among the item and other items of equipment, facilities, computer programs, and personnel. Conducted during Phase I,~~ DEM/VAL~~ (for prototypes), and Phase II, EMD (DoD 5000.2-R~~DoDI 5000.2~~)

PRODUCIBILITY The relative ease of manufacturing an item or system. The relative ease is governed by the characteristics and features of a design that enable economical fabrication, assembly, inspection, and testing using available manufacturing techniques. (DoD 5000.2-R~~DoDI 5000.2~~)

PRODUCTION The conversion of raw materials into products and/or components thereof, through a series of manufacturing processes. It includes functions of production engineering, controlling, quality assurance, and the determination of resources requirements. (Joint Pub 1-02)

PRODUCTION BASELINE The Production Baseline will contain objectives and thresholds for key cost, schedule and performance parameters which have been updated from the development baseline. The Production Baseline will be submitted as a stand-alone part of the Milestone III documentation. (DoD 5000.2-R~~DoDI 5000.2~~)

PRODUCTION PROTOTYPE (PP) A final model of a design before the pilot unit is approved for production. It should be highly representative of final equipment, except that the exact manufacturing assembly process and production design changes may not yet be used or incorporated. It is suitable for complete evaluation of its electrical and/or mechanical form and may be in a brassboard (technical and operational configuration. (EW T&E Task Force)

PROGRAM EXECUTIVE OFFICER (PEO) A military or civilian official who has primary responsibility for directing several acquisition category I programs and for assigned ACAT II, III, and IV programs. (DoD 5000.2-R~~DoDI 5000.2~~)

PROGRAM MANAGER (PM) A military or civilian official who is responsible for managing an acquisition program. (DoD 5000.2-R~~DoDI 5000.2~~)

PROTOTYPE A model suitable for evaluation of design, performance, and production potential. (Joint Pub 1-02)

PSYCHOLOGICAL OPERATIONS (PSYOP) Planned operations to convey selected information and indicators to foreign audiences to influence their emotions, motive, objective reasoning, and ultimately the behavior of foreign governments, organizations, groups, and individuals. The purpose of PSYOP is to induce or reinforce foreign attitude and behavior favorable to the originator's objectives. (CJCS MOP 30)

RELIABILITY The ability of a system and its parts to perform its mission without failure, degradation, or demand on the support system (DoD~~I~~ 5000-2-R)

RELIANCE STUDY The "Reliance" process for T&E is an outgrowth of the DoD Management Report Decision of November 1990 whose objectives were to "right-size" the T&E infrastructure for the future, to eliminate unwarranted duplication and to count, in the future, on inter-service "reliance" for non-service-peculiar T&E support capabilities. EW T&E is a key element of that study effort. (Reliance Study)

REQUIREMENT An established need justifying the timely allocation of resources to achieve a capability to accomplish approved military objectives, missions, or tasks. (Joint Pub 1-02)

REQUIREMENTS CORRELATION MATRIX (RCM) A management tool used to provide a system audit trail. It contains a comparison of the user's needs, system requirements, contractual specifications, and operational evaluation criteria. (EW T&E Task Force)

RISK A subjective assessment made regarding the likelihood or probability of not achieving a specific objective by the time established with the resources provided or requested. It also refers to overall program risk. (DoD 5000.2-R~~DoDI 5000.2~~)

SELF-PROTECTION EW systems which are integrated or carried on board a host platform and provide platform self-protection through active transmission or reflection of electromagnetic energy or destruction of enemy command, control, and communications systems. (DoD EW PLAN)

SIMULATION Simulation is a method for implementing a model. It is the process of conducting experiments with a model for the purpose of understanding the behavior of the system modeled under selected conditions or of evaluating various strategies for the operation of the system within the limits imposed by developmental or operational criteria. (DoD 5000.2-R~~DoDI 5000.2~~)

SPECIFICATIONS Contractual values that reflect the expected capabilities to be produced and/or fielded and that are traceable to the cost, schedule, and performance objectives of the acquisition program baseline. They are also tied to the acquisition phase in which the program is currently engaged and reflect the demonstration requirements is support of exit criteria. (DoD 5000.2-R~~oDI 5000.2~~)

SPECTRUM MANAGEMENT Planning, coordinating, and managing joint use of the electromagnetic spectrum through operational, engineering, and administrative procedures, with the objective of enabling electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference. (CJCS MOP 6)

SUPPORTABILITY The degree to which system design characteristics and planned logistics resources, meet system peacetime readiness and wartime utilization requirements. (DoD 5000.2-R~~DoDI 5000.2~~)

SUPPRESSION OF ENEMY AIR DEFENSES (SEAD) That activity which neutralizes, destroys, or temporarily degrades enemy air defenses in a specific area by physical attack, deception, and/or electronic warfare. (CJCS MOP 6)

SURGE An increase in the production or repair of defense goods of limited duration. (DoD 5000.2-R~~DoDI 5000.2~~)

SURVIVABILITY The capability of a system to avoid or withstand man-made hostile environments without suffering an abortive impairment of its ability to accomplish its designated mission. (DoD 5000.2-R~~DoDI 5000.2~~)

SUSCEPTIBILITY The degree to which a ~~device, equipment, or~~ weapon system is open to effective attack due to one or more inherent weaknesses. (Susceptibility is a function of operational tactics, countermeasures, probability of enemy fielding a threat, etc.) Susceptibility is considered a subset of survivability. (DoD 5000.2-R~~DoDI 5000-2~~)

SYNTHESIS In the T&E Process usage, synthesis is the combining and examining of processed information (Step Three) with expected outcomes (Step Two) and other information using both technical and operational judgment. (EW T&E Task Force)

SYSTEM Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific function. (Joint Pub 1-02)

SYSTEM EFFECTIVENESS A measure of the extent to which a system may be expected to achieve a set of specific mission requirements expressed as a function of availability, dependability, and capability. (EW T&E Task Force)

SYSTEM MATURITY MATRIX An acquisition management tool that can be used to highlight differences between the required objective and/or threshold values and the demonstrated values resulting from scheduled testing. (EW T&E Task Force)

SYSTEM PERFORMANCE PARAMETER (SPP) A measurable property of a system concept, a system design, or a system configuration that characterizes system performance, e.g., speed in knots or transmitted power in watts, that can be directly measured by instrumenting the system under test. (EW T&E Task Force)

SYSTEM RELIABILITY AND MAINTAINABILITY PARAMETER A measure of reliability or maintainability in which the units of measurement are directly related to operational readiness, mission success, maintenance manpower or logistic support cost. (DoD 5000.2-R~~DoDI 5000.2~~)

SYSTEM THREAT ASSESSMENT A systems-specific assessment that describes the threat to be countered and the projected threat environment. The threat assessment will be derived from DIA produced or validated documents. (DoD 5000.2-R~~DoDI 5000.2~~)

SYSTEMS ENGINEERING A comprehensive, iterative technical management process to: 1) Translate an operational need into a configured system meeting that need through a systematic, concurrent approach to integrated design of the system and its related manufacturing, test, and support processes; 2) Integrate the technical inputs of the entire development community and all technical disciplines into a coordinated effort that meets established program cost, schedule, and performance objectives; 3) Ensure the compatibility of all functional and physical interfaces and ensure that system definition and design reflect the requirements for all system elements; 4) Characterize technical risks, develop risk abatement approaches, and reduce technical risk through early test and demonstration of system elements. (DoD 5000.2-R~~DoDI 5000.2~~)

TECHNICAL DATA Scientific or technical information recorded in any form or medium (such as manuals and drawings). Computer programs and related software are not technical data; documentation of computer programs and related software are. Also excluded are financial data or other information related to contract administration. (DoD 5000.2-R~~DoDI 5000.2~~)

TECHNICAL PERFORMANCE PARAMETER (TPP) A selected subset of system-specific performance parameters used as the technical measures tracked in the systems engineering technical performance measurement program. TPPs are used to measure compliance with requirements and to assess the level of technical risk in a development program. (EW T&E Task Force)

TECHNICAL REQUIREMENTS FORMULATION The process of converting operational requirements into technical requirements that can be acted on by designers. (DSMC)

TEST AND EVALUATION (T&E) Any project or program designed to obtain, verify, and provide data for the evaluation of research and development other than laboratory experiments for the purpose of determining if the minimum acceptable operational performance requirements as specified in the Operational Requirements Document have been satisfied. (DoD 5000.2-R~~DoDI 5000.2~~)

TEST AND EVALUATION MASTER PLAN (TEMP) An overall T&E plan designed to identify and integrate the efforts and schedules of all T&E to be done in an acquisition program. (DoD 5000.2-R~~DoDI 5000.2~~)

TESTBED A system representation consisting partially of actual hardware and/or software and partially of computer models or prototype hardware and/or software. (DoD 5000.2-R~~DoDI 5000.2~~).

TEST CONDITIONS The environment (e.g., location, weather), scenario, and operating procedures and configurations for the SUT and adversaries in the test scenario. (EW T&E Task Force)

TEST ENVIRONMENT The test location, facility type, weather conditions, threat, electromagnetic and stimulation environments, etc., under which the test is conducted. (EW T&E Task Force)

TEST EVENT An activity during conduct of a test trial that requires a response by the system and/or personnel under test. (EW T&E Task Force)

TEST OBJECTIVE The specific performance or technical parameters to be measured during the test to evaluate system performance, system operational effectiveness, or system suitability. (EW T&E Task Force)

TEST RESOURCES A collective term that encompasses all elements necessary to plan, conduct, and collect/analyze data from a test event or program. (AR 73-1)

TEST SCENARIO A situation, representative of what the system under test may encounter in real life, that is used to enact a set of events between it and adversaries

included in the situation (e.g., threat simulator locations and flight profiles). (EW T&E Task Force)

TESTBED A system representation consisting partially of actual hardware and/or software and partially of computer models or prototype hardware and/or software. (DoD 5000.2-R~~DoDI 5000.2~~)

THREAT Current and future capabilities of a potential enemy force against one or more US developmental systems in terms of combat materiel, employment, doctrine, force structure, and combat environment. (AR 73-1)

THRESHOLD A minimum acceptable value for a performance parameter which, in the user's judgment, is necessary to provide an operational capability that will satisfy the mission need. The threshold must be met in order to gain approval from the milestone decision authority. (DoD 5000.2-R~~DoDI 5000.2~~)

UPGRADE A change to a system (whether for safety, to correct a deficiency, or to improve program performance) to a system that is out of production. Upgrades are part of the Milestone 0 decision process. (DoD 5000.2-R~~DoDI 5000.2~~)

VALIDATION The process of determining the degree to which a model is an accurate representation of the real-world from the perspective of the intended uses of the model. (DoDD 5000.59)

VALUE An assigned or calculated numerical quantity. An amount considered to be a suitable equivalent for something else. (AMERICAN HERITAGE DICTIONARY)

VERIFICATION The process of determining that a model implementation accurately represents the developers' conceptual description and specifications. (DoDD 5000.59)

VETRONICS Electrical and electronic systems aboard ground vehicles. (Commonly used military jargon that is a contraction of vehicle electronics) (EW T&E Task Force)

VULNERABILITY The characteristics of a system that cause it to suffer a definite degradation (loss or reduction of capability to perform the designated mission) as a result of having been subjected to a certain (defined) level of effects in an unnatural (man-made) hostile environment. Vulnerability is considered a subset of survivability. (DoD 5000.2-R~~DoDI 5000.2~~)

WARTIME RESERVE MODES (WARM) Characteristics and operating procedures of sensor, communications, navigation aids, threat recognition, weapons, and countermeasures systems that (a) will contribute to military effectiveness if unknown to or misunderstood by opposing commanders before they are used, but (b) could be exploited or neutralized if known in advance. Wartime reserve modes are deliberately

held in reserve for wartime or emergency use and seldom, if ever, applied or intercepted prior to such use. (CJCS MOP 6)

REPORT DOCUMENTATION PAGE

1. AGENCY USE ONLY (*Leave blank*)

2. REPORT DATE
   June 13, 1994
   Revision 1: September 18, 1995
   Revision 2: July 31, 1996

3. REPORT TYPE AND DATES COVERED
   Final Report, October 1993 to April 1994

4. TITLE AND SUBTITLE
   Task Force on Electronic Warfare Test and Evaluation Process - Final Report

5. FUNDING NUMBERS
   MDA970-89-C-0019/09-63

6. AUTHOR(S)
   Task Force on Electronic Warfare Test and Evaluation Process

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
   TRW T&E Engineering Services
   1755 Jefferson Davis Highway
   Suite 705~~202~~, Crystal Square 5
   Arlington, VA 22202

8. PERFORMING ORGANIZATION REPORT NUMBER
   DMC-S-94-0192

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
   Lt Col N. Johnson~~COL. C. Cook~~, Office of the Under Secretary of Defense (A&T)
   3000 Defense Pentagon
   Washington, D.C. 20301-3000

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
   Distribution Statement A, approved for public release, distribution is unlimited.

12b. DISTRIBUTION CODE

13 ABSTRACT (Maximum 200 words)

In July 1993, the House Armed Services Committee (HASC) expressed concern over the development process for airborne electronic combat systems. The committee stated one reason for this concern was the "lack of a comprehensive, integrated, and clearly defined electronic combat test process" that all services would follow and thereby improve the acquisition system. In response, the DoD Director, Test and Evaluation (T&E) convened a task force that included representatives from OSD, JCS, and the Services. This task force forwarded its recommendations in this final report in May 1994. In June 1994, OSD promulgated policy institutionalizing this T&E process for EW systems under OSD T&E oversight. This final report provides a history of key events and products leading to this new policy and a description of the T&E process for EW systems. Revision 2 reflects changes in the DoD acquisition process promulgated by DoD 5000.2-R, dated March 15, 1996.

14. SUBJECT TERMS

   Test and Evaluation (T&E), Electronic Warfare (EW), EW System Acquisition, oversight, IV&V

15. NUMBER OF PAGES

16. PRICE CODE

17 SECURITY CLASSIFICATION OF REPORT
   Unclassified

18. SECURITY CLASSIFICATION OF THIS PAGE
   Unclassified

19. SECURITY CLASSIFICATION OF ABSTRACT
   Unclassified

20. LIMITATION OF ABSTRACT
   Unlimited

Standard Form 298 (Rev. 2-89)